

THIS FILE COPY

AD-A211 470

Special Report 86-23

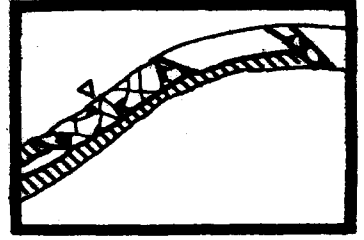
August 1986



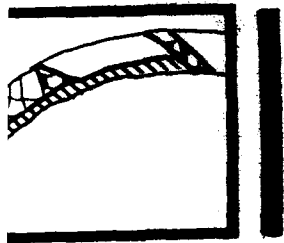
US Army Corps
of Engineers
Cold Regions Research &
Engineering Laboratory

ICE ATLAS 1984 - 1985

LAWRENCE GATTO
STEVEN F. DALY
KEVIN CAREY



KEVIN GAHEY



OHIO RIVER
ALLEGHENY RIVER
MONONGAHELA RIVER

DTIC
ELECTE
AUG 21 1989
S E D

Prepared for
OFFICE OF THE CHIEF OF ENGINEERS
Approved for public release; distribution is unlimited.

89 8 21 050

1

Unclassified SECURITY CLASSIFICATION OF THIS REPORT DOC		READ INSTRUCTIONS BEFORE COMPLETING FORM REPORTER'S CATALOG NUMBER	
1. REPORT NUMBER Special Report 86-23		AD-A211 470	
4. TITLE (and Subtitle) ICE ATLAS FOR THE OHIO, ALLEGHENY AND MONONGAHELA RIVERS, 1984-85		5. PERFORMING ORG. REPORT NUMBER	
7. AUTHOR(s) L.W. Gatto, S.F. Daly and K.L. Carey		8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Cold Regions Research and Engineering Laboratory Hanover, New Hampshire 03755-1290		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS RIM Work Unit 32228 RIM Work Unit 32227	
11. CONTROLLING OFFICE NAME AND ADDRESS Office of the Chief of Engineers Washington, D.C. 20314-1000		12. REPORT DATE August 1986	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 172	
		15. SECURITY CLASS. (of this report) Unclassified	
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE	
16. DISTRIBUTION STATEMENT (of this Report)			
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)			
18. SUPPLEMENTARY NOTES			
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Allegheny River Ohio River Ice reporting River ice Inland waterways Monongahela River			
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Ice conditions on inland rivers can change rapidly and adversely affect navigation. The ice maps in this atlas were prepared to document the 1984-85 ice conditions on those reaches of the Ohio, Allegheny and Monongahela Rivers that are included in study areas for the River Ice Management (RIM) Program, namely river mile 0 to 437 on the Ohio River, mile 0 to 7 on the Allegheny, and mile 0 to 66 on the Monongahela. The maps were prepared from interpretation of vertical aerial video imagery taken from a low-flying aircraft. The interpreted ice conditions were classified into five units and transferred to base maps by reference to navigation charts and topographic maps. <i>Fragmented Ice Cover</i> and <i>Ice Floes or Frazil Slush and Pans</i> were the most common ice units in the lower pools of the Monongahela River and lower Allegheny. <i>Solid Ice Cover</i> and <i>Fragmented Ice Cover</i> were the most common units in the upper pools of the Monongahela. <i>Fragmented Ice Cover</i> and <i>Open Water</i> were the most extensive units in the Emsworth to New Cumberland pools of the Ohio; <i>Open Water</i> and <i>Ice Floes or Frazil Slush and Pans</i> were the predominant units in the downstream pools. There were frequent cancellations of flights during the 1984-85 winter because of low cloud ceilings. To get more frequent video coverage of ice during the 1985-86 winter, a wider-angle lens on the video camera will be used. This will allow flights at a lower altitude, permitting video coverage even when the ceiling is low.			

DTIC
JUL 1986
R0021388
S E D

unclassified

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

This report was prepared by Lawrence W. Gatto, Geologist, Earth Sciences Branch, Research Division; Steven F. Daly, Research Hydraulic Engineer, and Kevin L. Carey, Research Hydraulic Engineer, both of the Ice Engineering Research Branch, Experimental Engineering Division, U.S. Army Cold Regions Research and Engineering Laboratory. The work was funded by the Office of the Chief of Engineers, under the River Ice Management (RIM) Program, Work Units 32228, *Remote Ice Monitoring System*, and 32227, *Forecasting Ice Conditions on Inland Rivers*.

Northland Video Associates, Inc., of Lebanon, New Hampshire, under contract to CRREL, acquired the aerial video tapes used for mapping ice conditions. Photographic Interpretation Corporation (PIC) of Lyme, New Hampshire, prepared the river ice maps under a contract to the New England Division of the Corps of Engineers. Vernon Anderson of PIC interpreted and mapped ice conditions from the video tapes, and Roger Arend of PIC measured the areal extent of the ice types and percentages of ice concentration. The authors thank Darryl Calkins and Michael Ferrick for technical reviews of the manuscript, Eleanor Huke for her assistance in planning and preparing the base maps, and Richard Sterling for compiling the data shown in Appendix A.

The contents of this report are not to be used for advertising or promotional purposes. Citation of brand names does not constitute an official endorsement, approval or disapproval of the use of such commercial products.

	Page
Abstract.....	i
Preface.....	ii
Index.....	ii
Introduction.....	1
Background.....	1
Area of study.....	1
Approach.....	1
Results.....	2
Allegheny River.....	2
Monongahela River.....	2
Ohio River.....	2
Conclusions.....	2
Maps of ice conditions.....	2
Appendix A: Areas of mapped ice units.....	3
Appendix B: Video tape coverage.....	179
Addendum.....	185
.....inside back cover	

Figure

1. Location of the study area on the Allegheny, Monongahela and Ohio Rivers, showing locations of locks and dams.
2. Dates of video tape acquisition

Table

1. Ice conditions as observed on video tapes..... 2

[illegible]

INDEX

Pool, River	January							February							March						
	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13
Emsworth, Allegheny	3	5	7	13	19	27	33	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emsworth, Monongahela	3	5	7	13	19	27	33	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L/D 2, Monongahela*	—	—	8	14	—	28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L/D 3, Monongahela	—	—	9	15	—	29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L/D 4, Monongahela	—	—	10	16	—	30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Maxwell, Monongahela	—	—	11	17	—	31	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emsworth, Ohio	—	—	—	—	20	—	34	47	—	—	—	—	—	—	—	—	—	—	—	—	—
Dashields, Ohio	—	—	—	—	20	—	34	47	—	—	—	—	—	—	—	—	—	—	—	—	—
Montgomery, Ohio	—	—	—	—	21	—	35	48	59	—	—	—	—	—	—	—	—	—	—	—	—
New Cumberland, Ohio	—	—	—	—	22	—	36	49	60	—	—	—	—	—	—	—	—	—	—	—	—
Pike Island, Ohio	—	—	—	—	23	—	37	50	61	—	—	—	—	—	—	—	—	—	—	—	—
Hannibal, Ohio	—	—	—	—	25	—	39	52	63	—	—	—	—	—	—	—	—	—	—	—	—
Willow Island, Ohio	—	—	—	—	—	—	41	54	—	—	—	—	—	—	—	—	—	—	—	—	—
Belleville, Ohio	—	—	—	—	—	—	43	56	—	—	—	—	—	—	—	—	—	—	—	—	—
Racine, Ohio	—	—	—	—	—	—	—	—	70	—	—	—	—	—	—	—	—	—	—	—	—
Gallipolis, Ohio	—	—	—	—	—	—	—	—	72	—	—	—	—	—	—	—	—	—	—	—	—
Greenup, Ohio	—	—	—	—	—	—	—	—	74	—	—	—	—	—	—	—	—	—	—	—	—
Meldahl, Ohio	—	—	—	—	—	—	—	—	78	—	—	—	—	—	—	—	—	—	—	—	—

* L/D—lock and dam.

Accession for
 Date
 Author
 Title
 Subject
 Series
 Volume
 Page
 Box
 Shelf
 Call Number
 Remarks
 Disc Special

Ice Atlas for the Ohio, Allegheny and Monongahela Rivers, 1984-85

L.W. GATTO, S.F. DALY and K.L. CAREY

INTRODUCTION

Background

The Corps of Engineers has broad responsibility for providing reliable avenues for waterborne commerce by operating and maintaining the Nation's navigable waterways. Across the northern United States, ice greatly impedes and occasionally stops winter navigation on some rivers and waterways. This creates a need to develop ice control techniques that will permit cost-effective, reliable and safe navigation throughout the year, without adverse economic or environmental effects.

The purpose of the Corps' River Ice Management (RIM) Program is to develop the structural and operational solutions to ice problems on navigable rivers that currently experience winter shipping delays and unexpected ice emergencies. Information on river ice conditions has not been previously collected on a large scale over long periods. This has impeded our understanding of river ice processes. This atlas will provide a permanent record of the ice conditions over these river reaches that should prove valuable to any future research. In addition, this information is required throughout the winter as input data and "ground truth" for developing river ice forecast models and for developing and evaluating various remote sensing devices for real time monitoring of ice conditions.

Repetitive coverage of ice conditions is required for documenting changes and for understanding the dynamics of river ice. Personnel at the Corps' lock-and-dam projects make daily observations of nearby ice conditions, but these data are not necessarily representative of ice conditions in the pools between the locks and dams. Consequently, their ob-

servations are of limited use for analyzing conditions over long stretches of the river. The Corps occasionally takes low-altitude oblique and vertical aerial photographs when ice conditions cause navigation problems, but there is usually no systematic collection of photographs every winter. Based on a sample video tape taken during the 1983-84 winter, videography was selected as a reliable and economical method to document ice conditions for the RIM Program.

The purpose of this ice atlas is to document the areal extent and variation through time of river ice and open water in the area of study during the 1984-85 winter. No detailed analyses of the ice conditions were done in preparing this atlas beyond placing the observed ice into general categories. The *Results* section provides very general descriptions of ice conditions, highlighting the ice categories and providing an introduction and guide to the ice information contained in the maps themselves.

Area of study

Ice conditions were to be documented on the Ohio River (Fig. 1) from Pittsburgh Point (river mile 0) to river mile 437, just downstream of Mel-dahl Locks and Dam, on the Monongahela from the Point (mile 0) to mile 66, just upstream of Maxwell Lock and Dam, and on the Allegheny from the Point (mile 0) to mile 7, just upstream of Lock and Dam 2. However, as discussed in the *Results* section, coverage of the entire study area was not always possible on each flight date.

There are 12 dams and associated locks in the study area of the Ohio River, four along the Monongahela and one on the Allegheny. Navigation channels at least 9 ft deep are maintained.

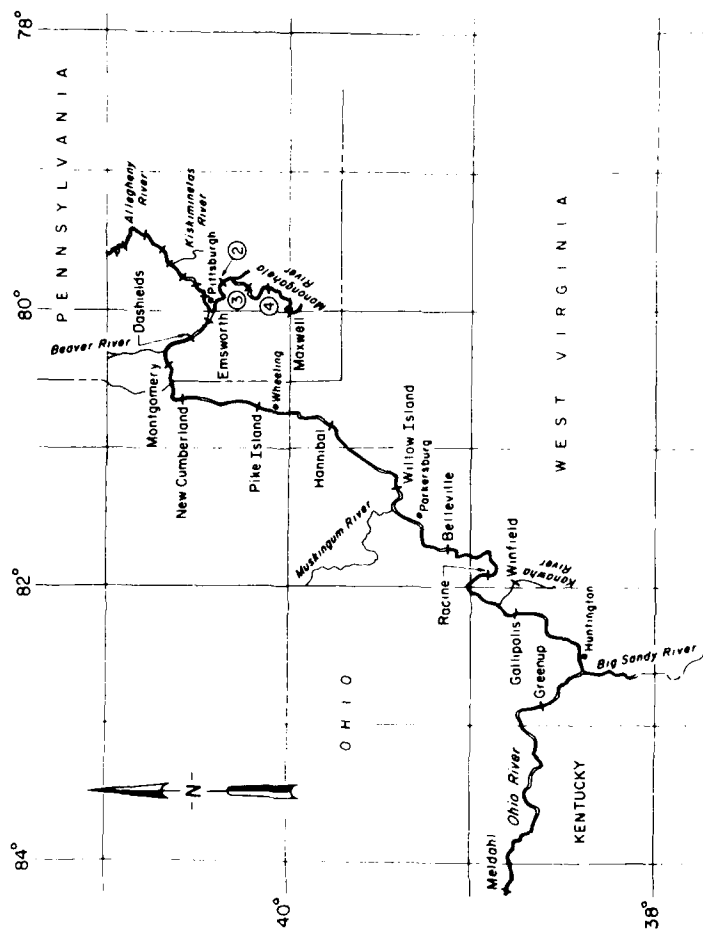


Figure 1. Location of the study area on the Allegheny, Monongahela and Ohio Rivers, showing locations of locks and dams.

APPROACH

Video tapes (1/2 in. VHS) were taken vertically with a Panasonic video camera with a 12.1 zoom lens from a Cessna 441 fixed-wing aircraft, usually at an altitude between 2000 and 3500 ft above the ground. Aircraft altitude varied depending on cloud conditions. Occasionally, the aircraft was not cleared to enter the controlled air space around Pittsburgh International Airport, and thus tapes could not be acquired of the Ohio River from Pittsburgh Point to the vicinity of Ambbridge, Pennsylvania (river mile 0 to 24).

The tapes were viewed on a TV monitor and the observed ice was visually interpreted and classified into five units (Table 1). The acquisition of "ground truth" was not required, since the image interpretation was limited to the classification of the ice conditions as seen on the video tapes by an experienced ice interpreter/observer, and did not attempt to infer characteristics that could only be measured "on the ground" (e.g., porosity, strength or ice thickness). Boundaries between the units were transferred to 1:24,000 base maps by reference to Corps of Engineers navigation charts and U.S. Geological Survey topographic maps. The maps are organized according to the pools that exist between the dams. A pool is named for the dam at its downstream end, as listed in the index and subsequently in this report.

The ice maps show the areal extent of the five ice types and open water. These six units were selected because they are readily identifiable on video imagery and they satisfactorily describe the range of ice that can occur on inland waterways.

The area of each map unit in a pool was measured from the base maps with a Los Angeles Scientific Instruments Co. digital compensating polar-planimeter. For map units comprising both ice and open water, the surface concentration of ice was visually estimated with a probable accuracy of $\pm 5\%$. This included three ice types: *Solid Ice Cover with Open Areas*, *Fragmented Ice Cover with Open Areas*, and *Ice Floes or Frazil Slush and Pans*. The surface concentrations for the *Solid Ice Cover* and *Fragmented Ice Cover* are always 100% (Table 1). The measured areas and estimated concentrations are listed in Appendix A.

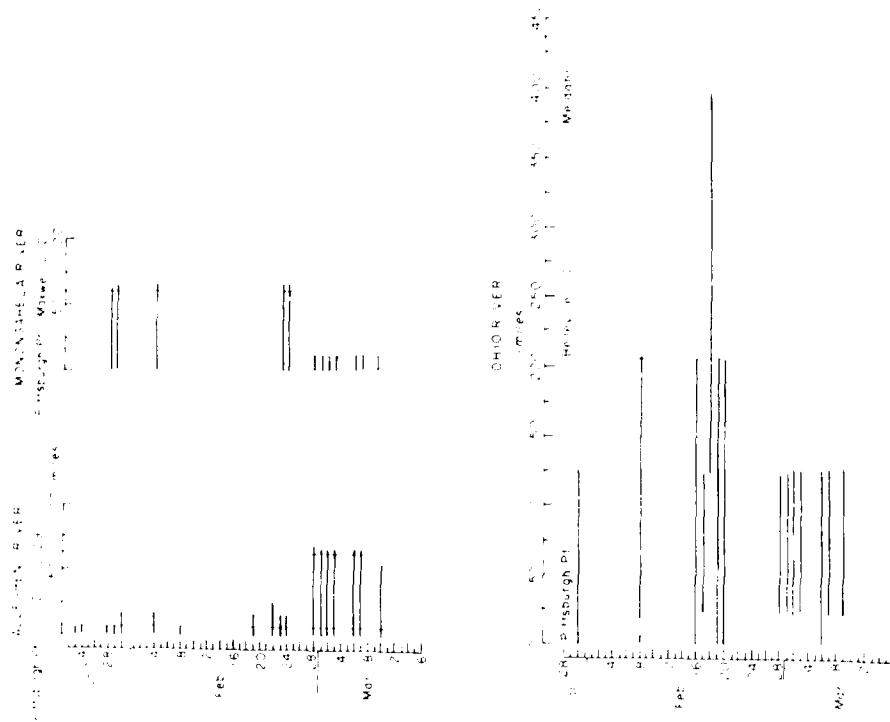


Figure 2. Dates of video tape acquisition (see also Appendix B). The vertical dashed lines indicate the extent of the aerial video contracts.

Allegheny River

Fragmented Ice Cover and *Fragmented Ice Cover with Open Areas* covered about 90% of the Emworth pool on 23 January and remained the predominant ice types through 30 January. By 4 February about 60% of the pool was covered with *Solid Ice Cover* while *Fragmented Ice Cover* with *Open Areas* covered only 18%. From 8 through 24 February the coverage of these ice units decreased as *Ice Floes or Frazil Slush and Pans* and *Open* after increased. After 28 February this reach was open.

Table 1. Ice conditions as observed on video tapes.

Map unit	Description
Open Water	River is ice-free; no ice apparent.
Solid Ice Cover	River is completely covered (100%) with ice; no individual ice pans, blocks or chunks are visible; ice may be snow-covered.
Solid Ice Cover with Open Water Areas	River is partially covered with solid ice (as described above) but has open (ice-free) areas.
Fragmented Ice Cover	River is completely covered (100%) with ice that is ice-free, variably sized, individual ice pans.

covered about 90% of the river in pools on 23 January and remained the predominant ice types through 30 January. By 4 February about 60% of the pool was covered with *Solid Ice Cover* while *Fragmented Ice Cover* and *Open Areas* covered only 18%. From 8 through 24 February the coverage of these ice units decreased as *Ice Floes or Frazil Slush* and *Pans* and *Open Water* increased. After 28 February this reach was open.

Monongahela River

Fragmented Ice Cover and *Fragmented Ice Cover with Open Areas* were the most widespread types on the five pools of the Monongahela, and covered as much as 57% of the pools on 4 February. *Solid Ice Cover* covered 63% of the Lock and Dam 4 pool on 28 January and was more widespread on the upper three pools. Generally, *Ice Floes or Frazil Slush* and *Pans* was the more common ice type on the downstream pools. By 23 February most of the pools were ice-free, except for isolated patches of *Ice Floes or Frazil Slush* and *Pans*.

Ohio River

Fragmented Ice Cover and *Fragmented Ice Cover with Open Areas* were the most widespread; they covered nearly 80% of the Emsworth pool on 16 February. *Ice Floes or Frazil Slush* and *Pans* was second in area, although *Open Water* existed over large portions of the pools. *Solid Ice Cover* was more common on the upstream reaches, although it covered small areas downstream at this time. Ice was present in some form on all reaches from Emsworth to Belleville on 30 January; by 20 February most of the ice was gone.

CONCLUSIONS

Videography proved to be an economical, effective and accurate way to document the rapidly changing ice conditions. However, cloud cover, inclement weather and low ceilings restricted the opportunities for getting more frequent video coverage and sometimes caused large gaps in the video record. It is critical to get more frequent coverage in the future. During the 1985-86 winter, a wider-angle will be used on the video camera, which will allow bank-to-bank video coverage while the airplane is flying at lower altitudes when the ceiling is low. Videographic techniques also provide near-real-time data during periods of extreme ice conditions.

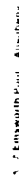
Solid Ice Cover with Open-Water Areas	River is partially covered with solid ice (as described above) but has open (ice-free) areas.
Fragmented Ice Cover	River is completely covered (100%) with ice that has distinct, variably sized, individual ice pans, blocks or chunks.
Fragmented Ice Cover with Open-Water Areas	River is partially covered with fragmented ice (as described above) but has open (ice-free) areas.
Ice Floes or Frazil Slush and Pans	River is primarily open (ice-free) with floating ice floes, slush or pans.

RESULTS

Ice conditions were documented on video tapes on 23 dates during the 1984-85 winter (Fig. 2). Note that tapes of the lower Ohio River from mile 210 to near Meldahl Dam were acquired on 18 February only. No additional tapes of these lower river pools were obtained because of frequent poor weather and low ceilings. In the latter portion of the winter, from 28 February to 10 March, documentation of the Allegheny River ice conditions was expanded to river mile 65. During this period, documentation of the Monongahela River ice conditions was reduced to only river mile 0 to 12. The reason for these changes was that more of the Allegheny had ice cover later in the winter than did the Monongahela. No maps of the Allegheny upstream of Lock and Dam 2 have been prepared; however, video documentation of the upstream sections was desired.

Ice conditions on the rivers change rapidly, often daily. In late January ice was extensive, but by late February most of it was gone. *Fragmented Ice Cover*, *Fragmented Ice Cover with Open Areas*, and *Ice Floes or Frazil Slush and Pans* were most common in the lower pools of the Monongahela and lower Allegheny. Solid and fragmented ice, both with and without open areas, were most common in the upper pools of the Monongahela. *Fragmented Ice Cover* and *Open Water* were most extensive in the Emsworth to New Cumberland pools of the Ohio; *Open Water* and *Ice Floes or Frazil Slush and Pans* were most common in the downstream pools.

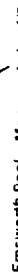
23 January 1985

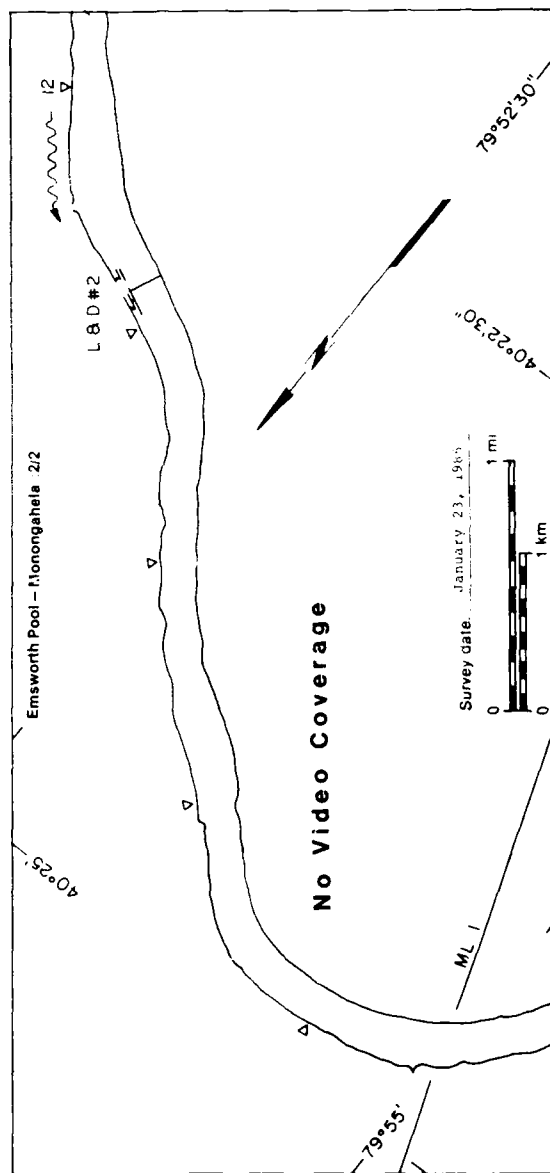
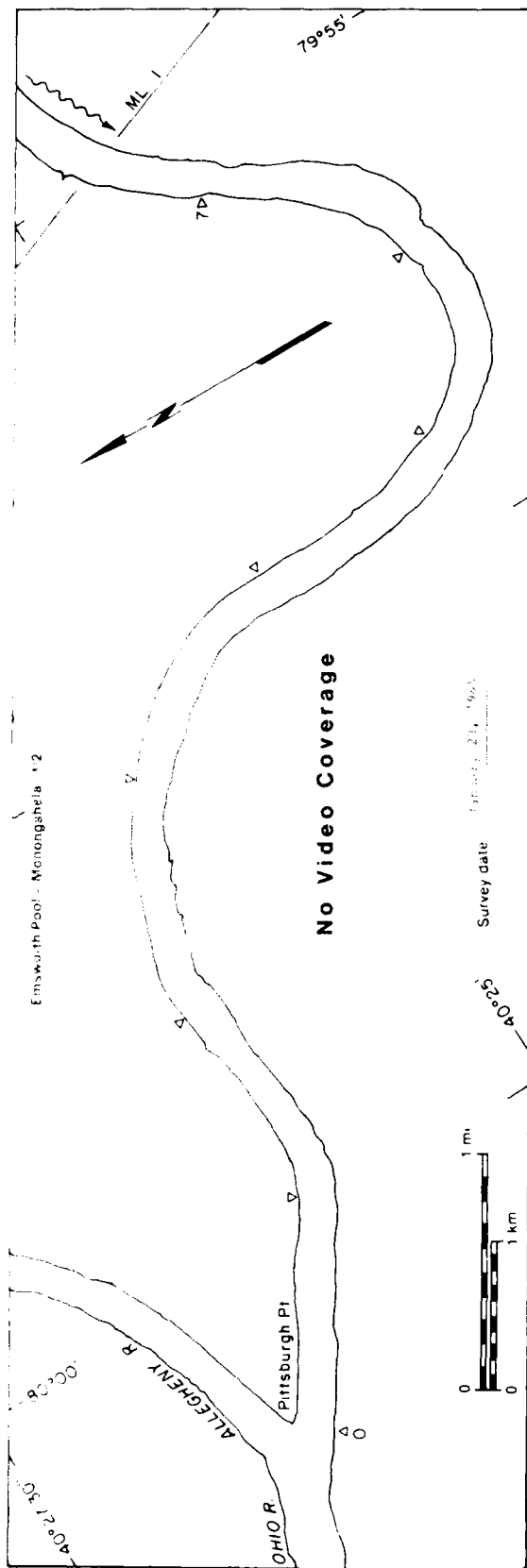


100

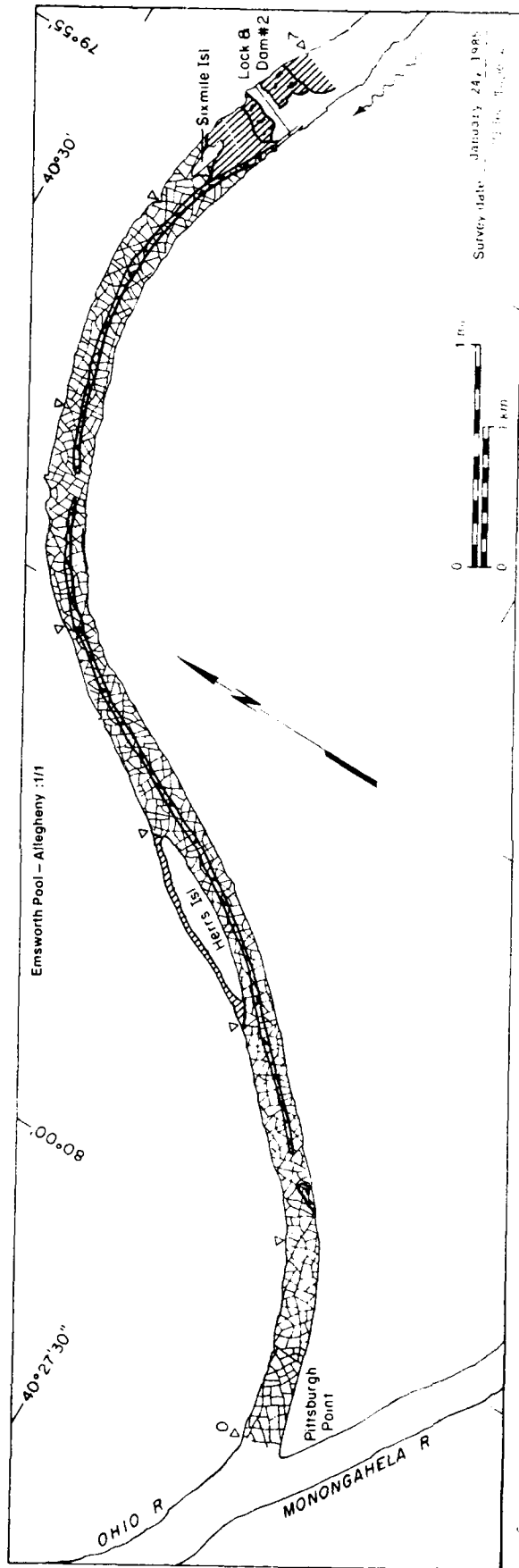
2 - 5 cm x 10 cm x 10 cm

100





24 January 1985

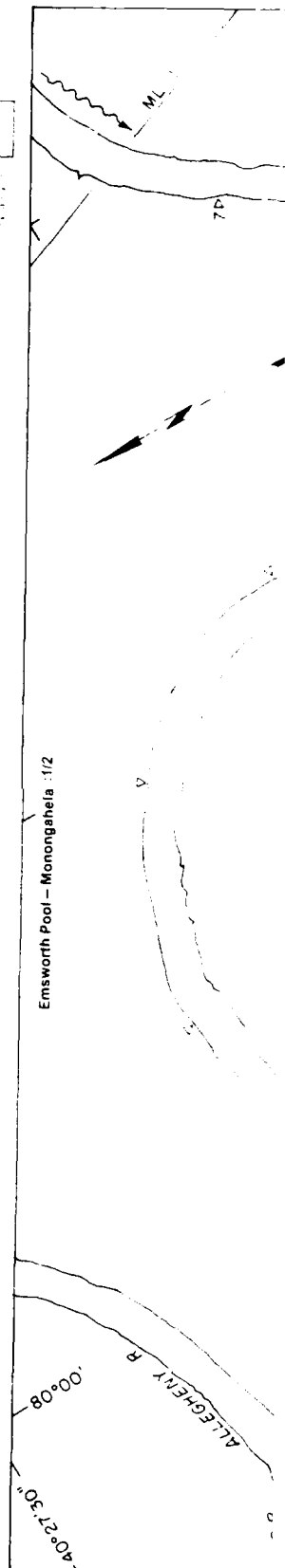


Emsworth Pool - Allegheny

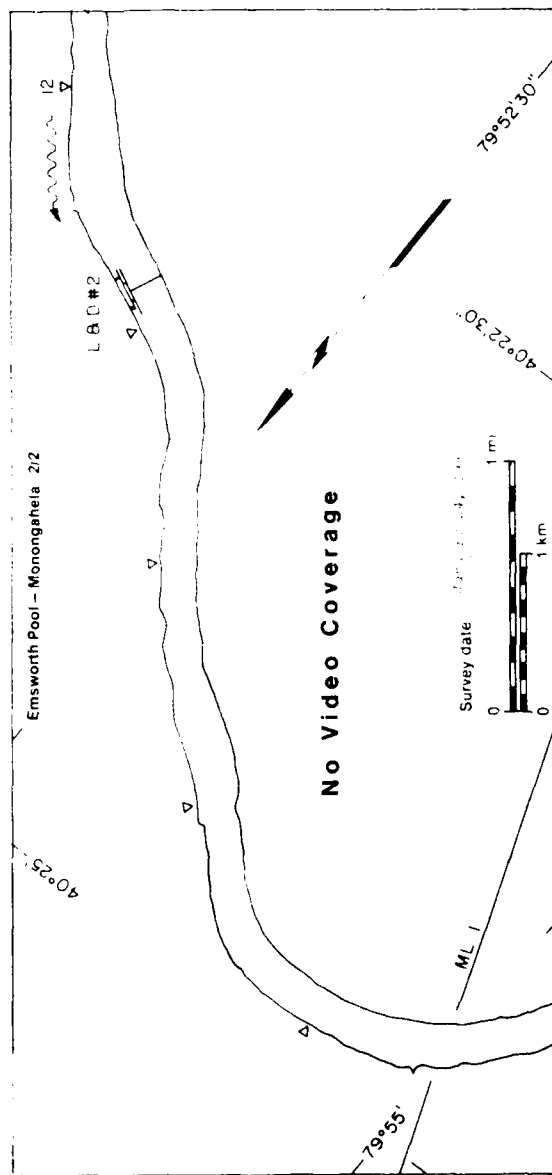
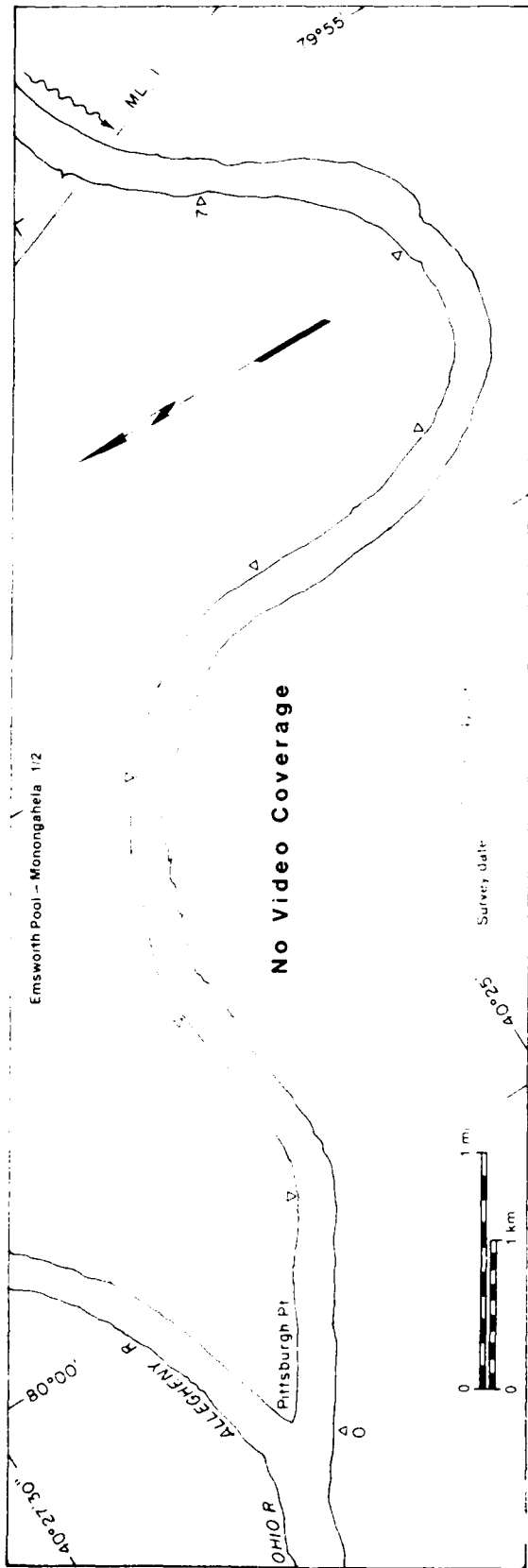
Map Unit	Area (sq. mi.)
Water	0.16
Soil	0.29
Grassland	0.16
Forest	2.27
Barren land	0.39
Unlabeled	---
Total Area	3.27

Emsworth Pool - Monongahela

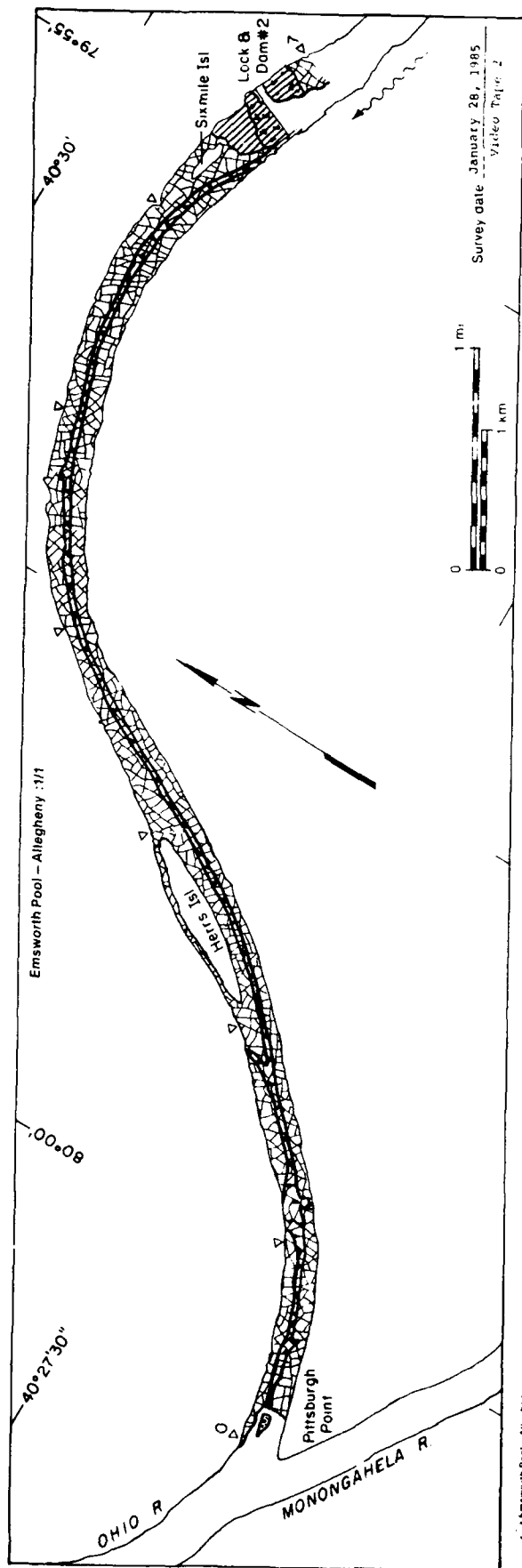
Map Unit	Area (sq. mi.)
Water	0.16
Soil	0.29
Grassland	0.16
Forest	2.27
Barren land	0.39
Unlabeled	---
Total Area	3.27



Emsworth Pool - Monongahela



28 January 1985

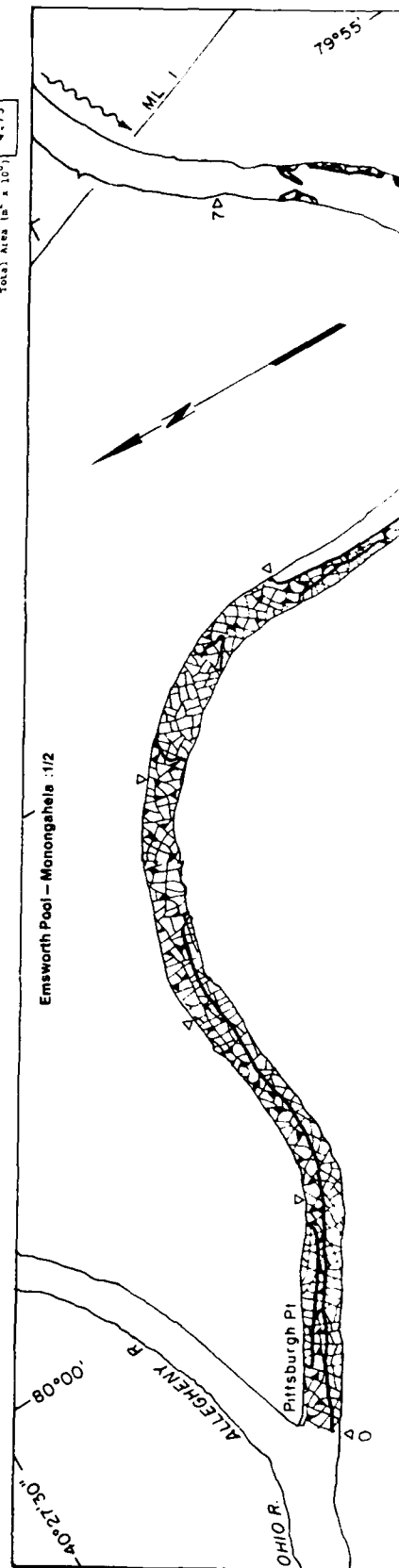


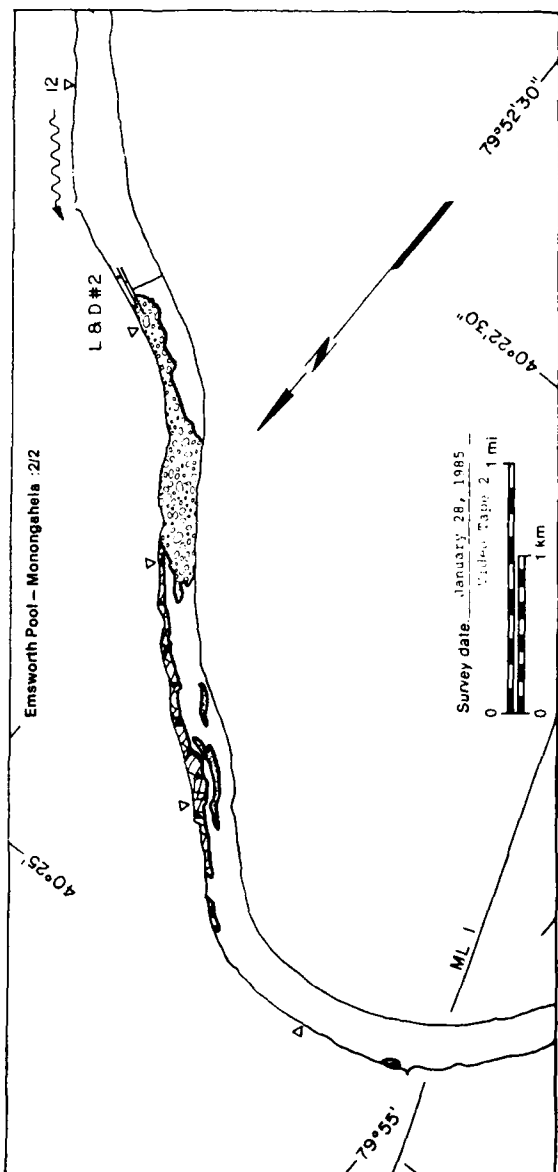
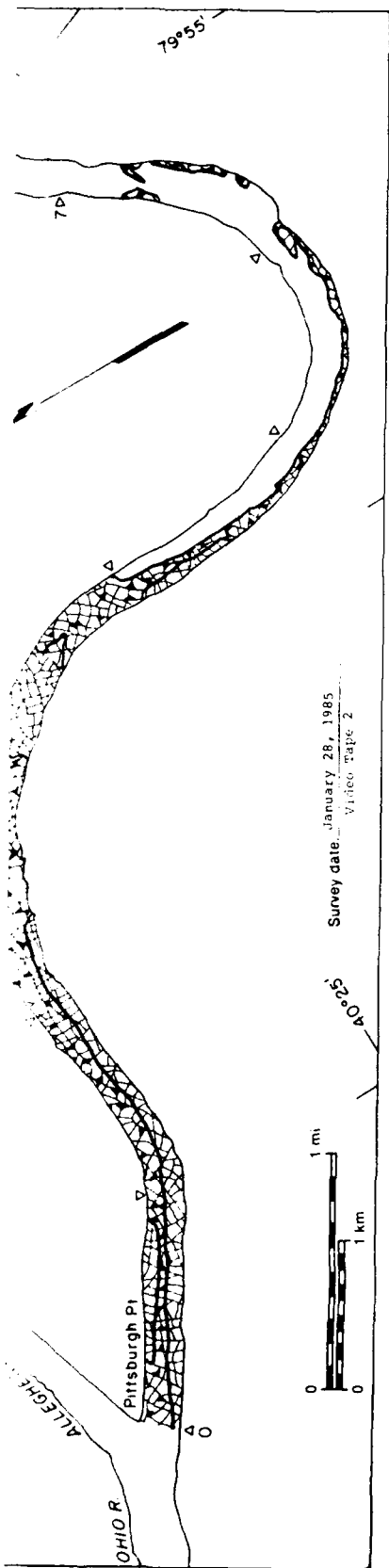
1. Emsworth Pool - Allegheny

Map Area	Surface Area (sq. ft.)	Substrate
Water	0.18	NA
Wetland	0.07	NA
Forested area with open water areas	0.12	80
Forested area with open water areas	2.36	NA
Forested area with open water areas	0.53	95
Forested area with open water areas	0.01	2
Total Area (sq. ft. x 10⁶)	3.27	

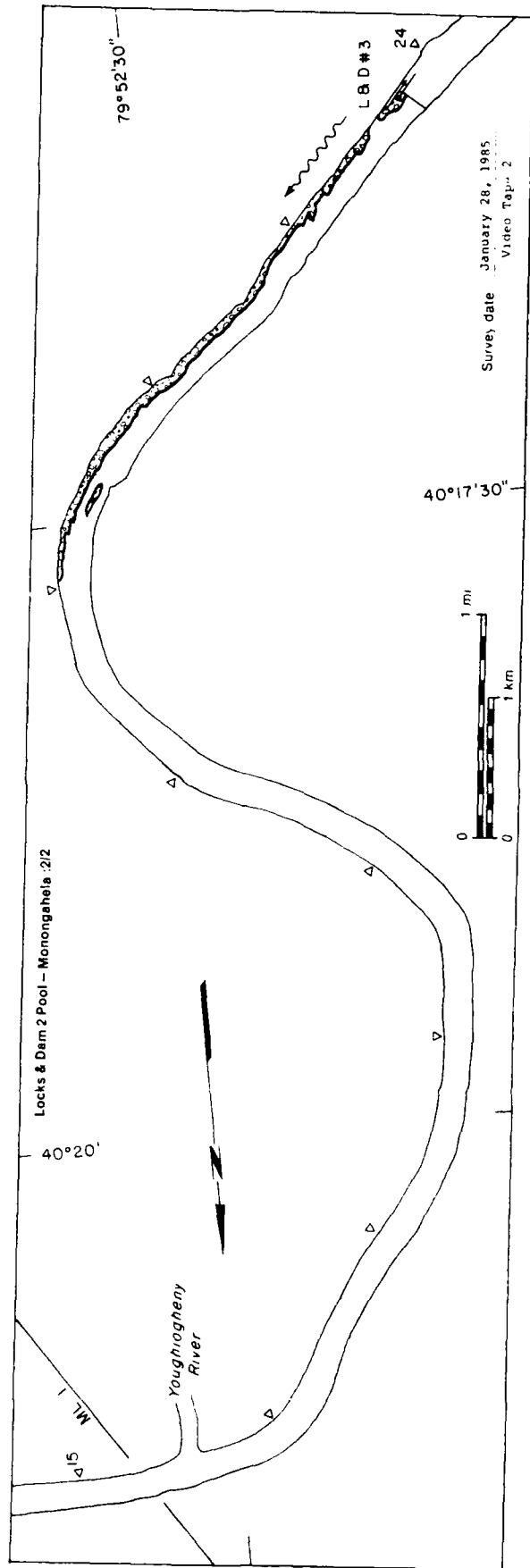
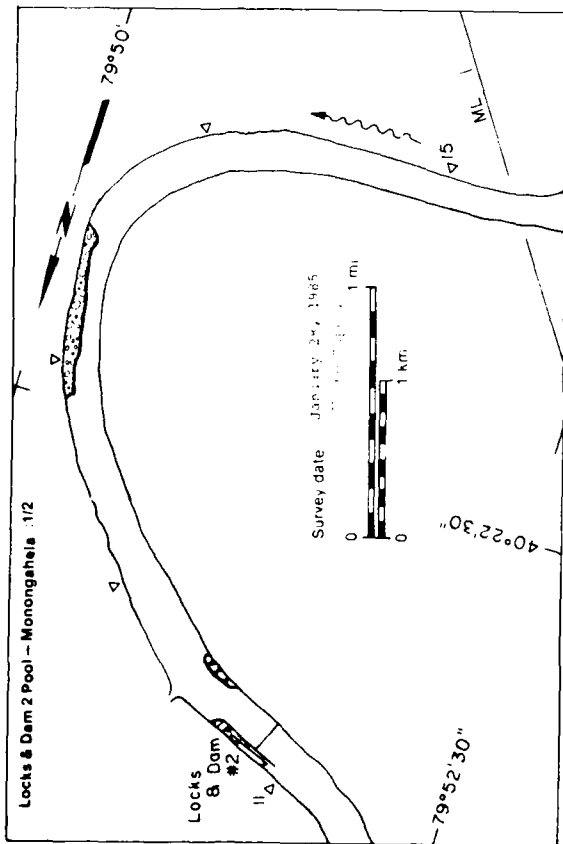
2. Emsworth Pool - Monongahela

Map Area	Surface Area (sq. ft.)	Substrate
Water	2.23	NA
Wetland	NA	NA
Forested area with open water areas	NA	NA
Forested area with open water areas	0.74	NA
Forested area with open water areas	1.40	80
Forested area with open water areas	0.36	10
Total Area (sq. ft. x 10⁶)	4.73	





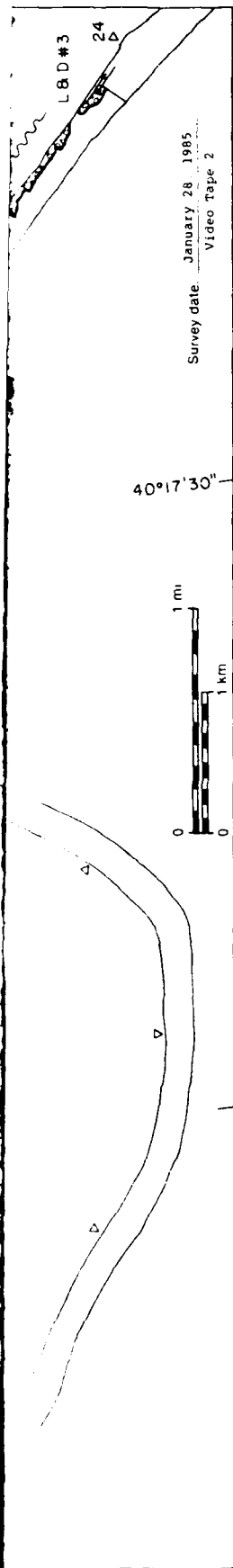
28 January 1985



Locks & Dam 2 Pool - Monongahela

MAP UNITS		Surface concentration (g)
Area (m ² x 10 ⁶)	Concentration (g)	
4.36	NA	

Open water



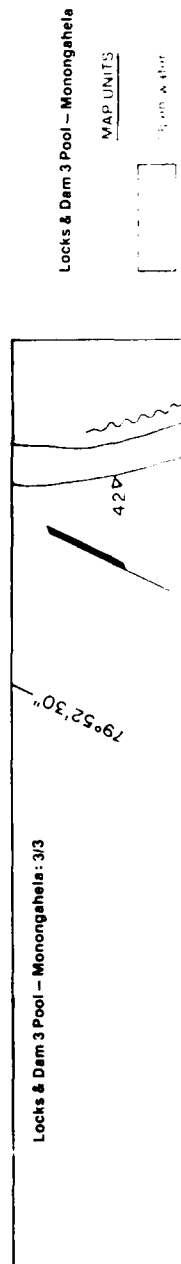
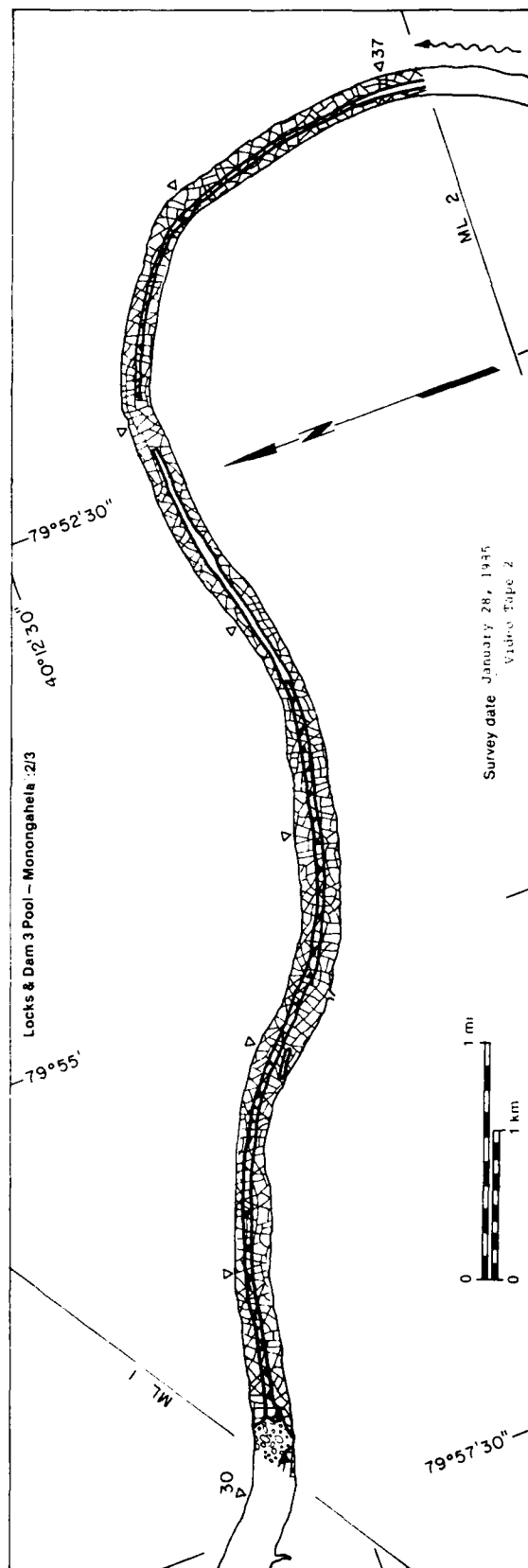
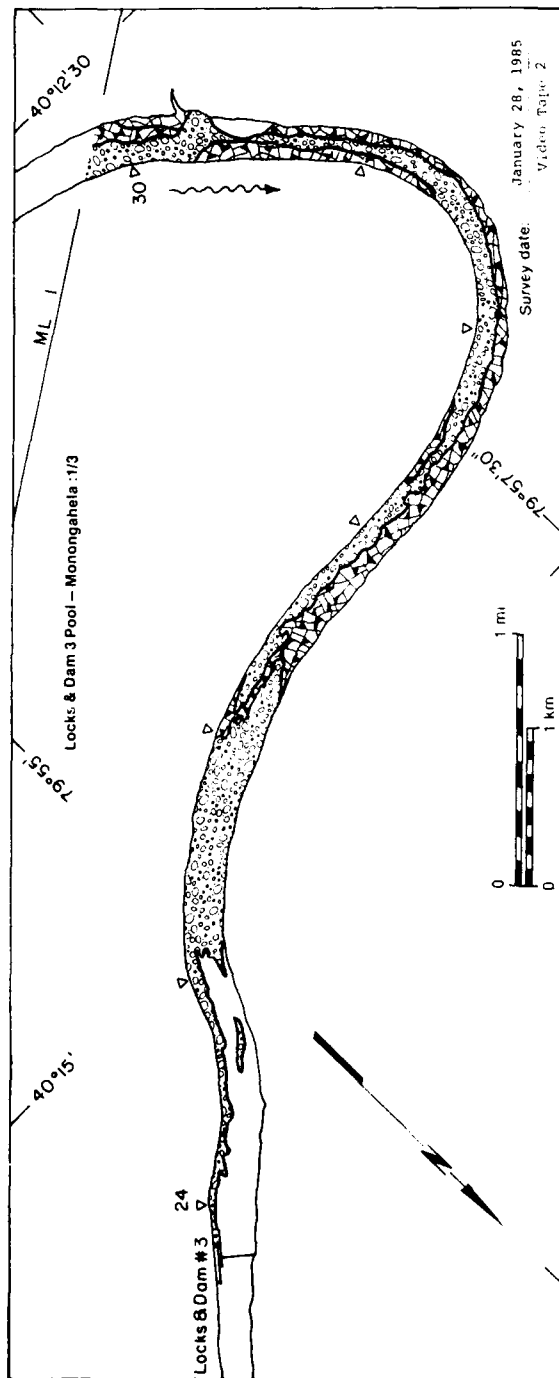
Locks & Dam 2 Pool - Monongahela

MAP UNITS



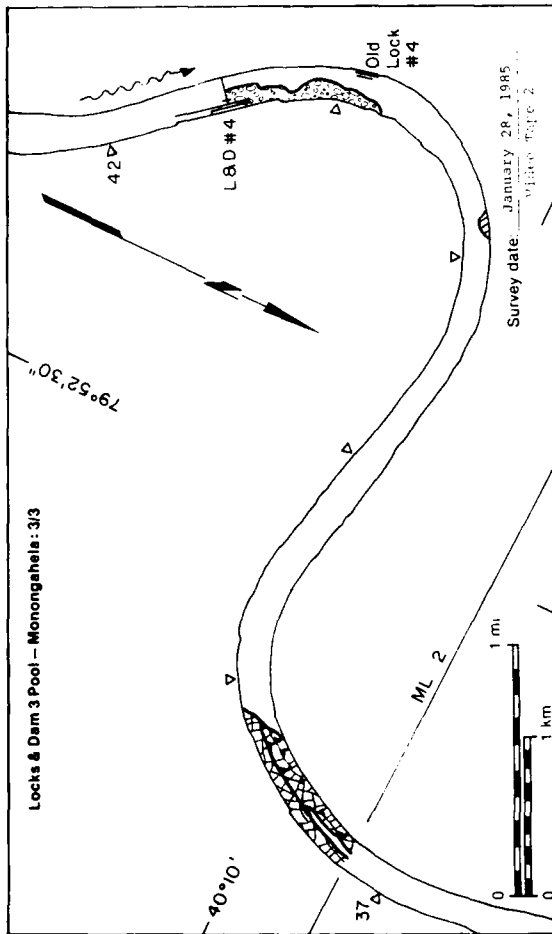
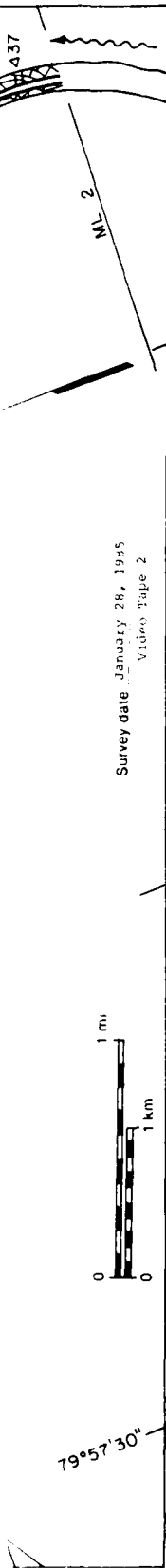
MAP UNITS	Area ($m^2 \times 10^6$)	Surface concentration (%)
Open water	4.36	NA
Solid ice cover	--	NA
Solid ice cover with open-water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	0.04	90
Ice floes or frazil slush and pans	0.37	10
Total Area ($m^2 \times 10^6$)	4.77	

28 January 1985



MAP UNITS

Surface concentration	NA
Scale 1:100,000	NA



Locks & Dam 3 Pool - Monongahela

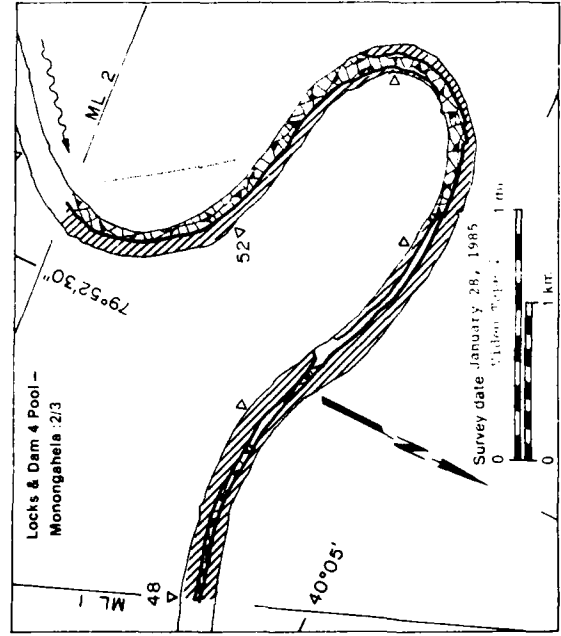
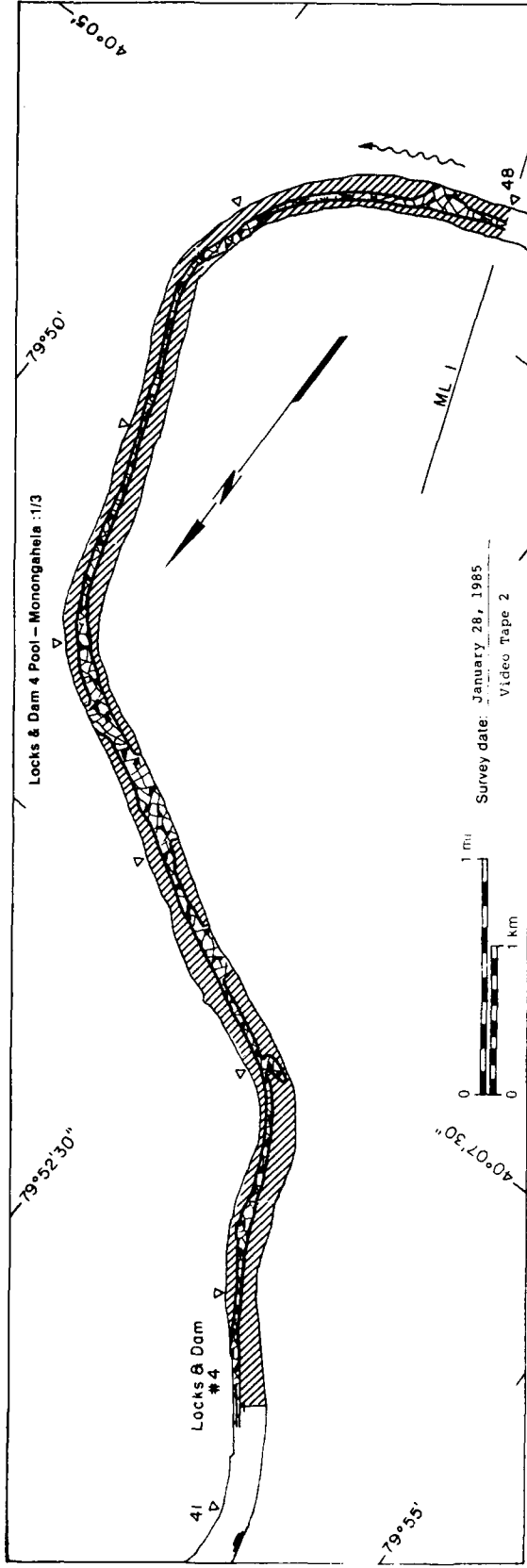
MAP UNITS

	Open water
	Solid ice cover
	Solid ice cover with open-water areas
	Fragmented ice cover
	Fragmented ice cover with open-water areas
	Ice floes or frazil slush and pans

Area, $\text{m}^2 \times 10^6$	Surface concentration (%)
1.74	NA
0.01	NA
--	--
2.15	NA
1.18	75
1.56	20
6.64	

Total Area ($\text{m}^2 \times 10^6$)

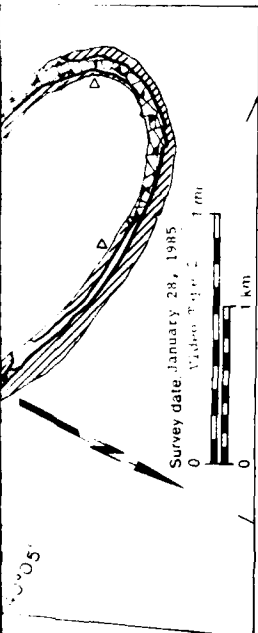
28 January 1985



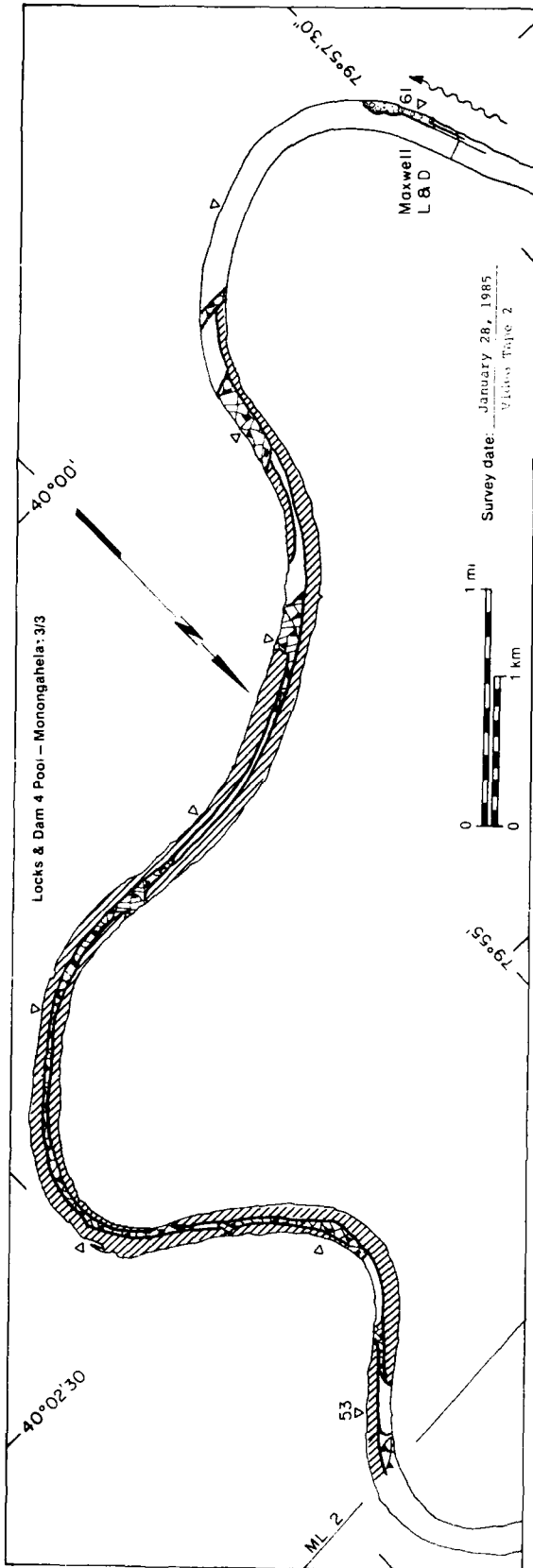
Locks & Dam 4 Pool - Monongahela

MAP UNITS	Area ₆ (m ² x 10 ⁶)	Surface concentration (%)
Open water	0.77	NA
Solid ice cover	4.19	NA
Solid ice cover with open-water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open-water areas	1.61	80
Ice floes or frazil slush and pans	0.03	2
Total Area (m ² x 10 ⁶)	6.60	

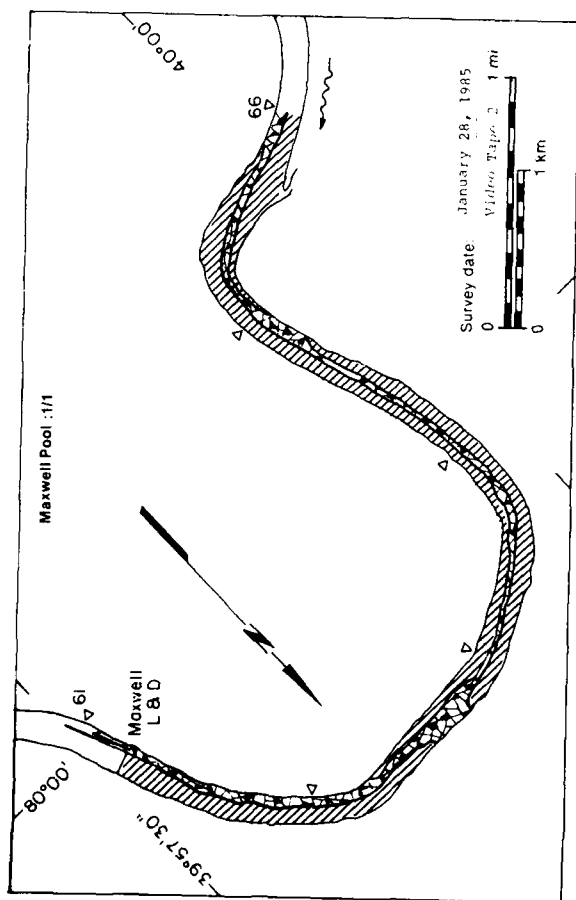




	Fragmented ice cover	NA
	Fragmented ice cover with open-water areas	1.61
	Ice floes or frazil slush and pans	0.03
Total Area ($m^2 \times 10^6$)		6.60

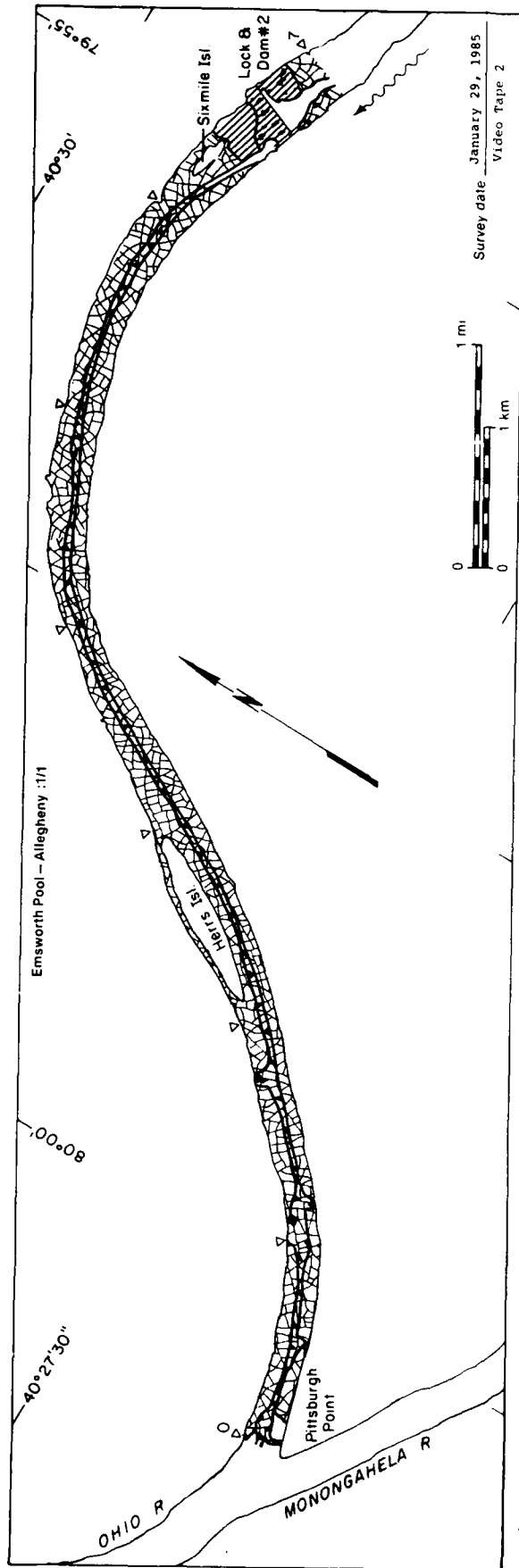


28 January 1985



Maxwell Pool		Surface concentration
MAP UNITS	Area (m ² x 10 ⁶)	(%)
Open water	0.05	NA
Solid ice cover	1.08	NA
Solid ice cover with open water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open water areas	0.43	80
Ice floes or frazil slush and pans	--	--
Total Area (m ² x 10 ⁶)	1.56	

29 January 1985

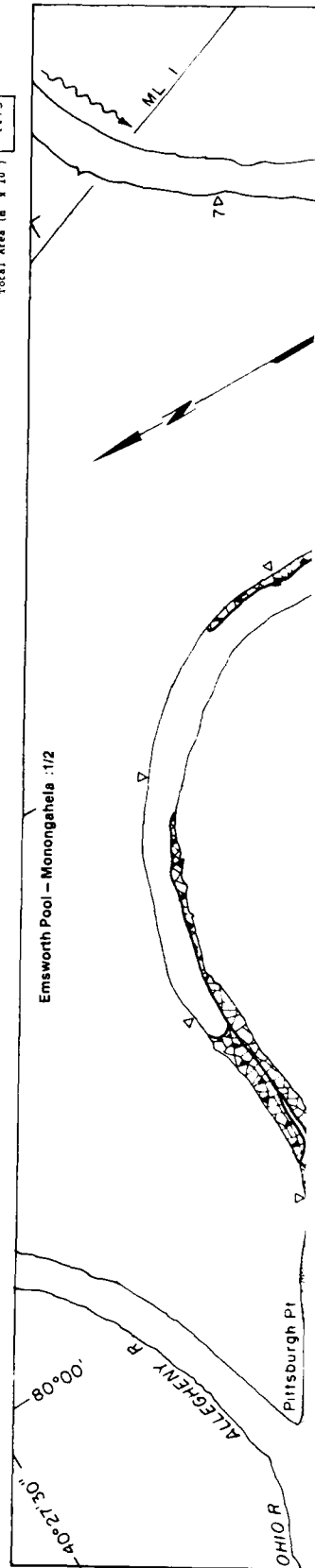


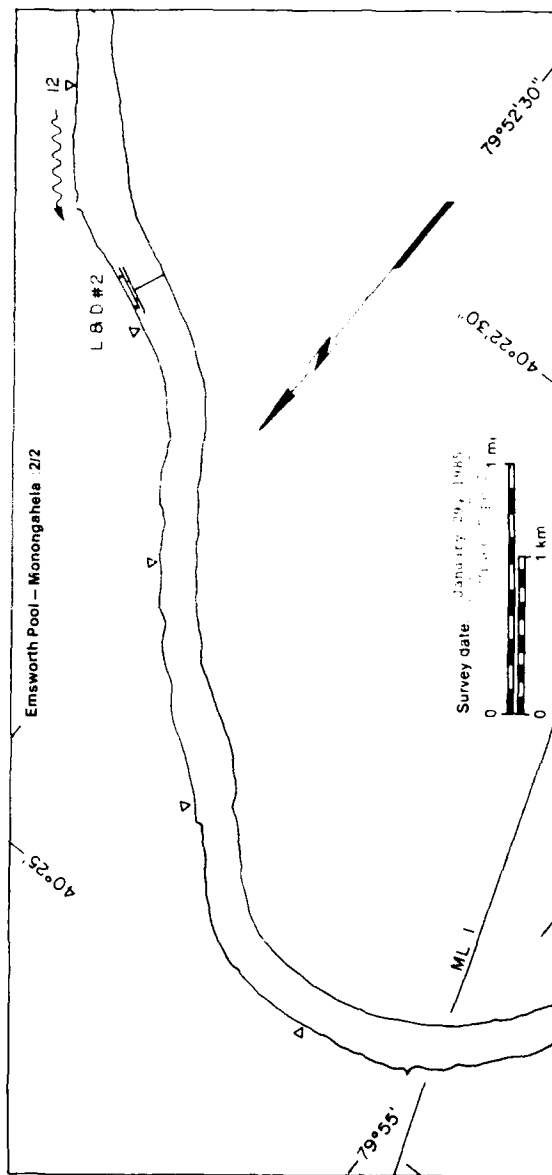
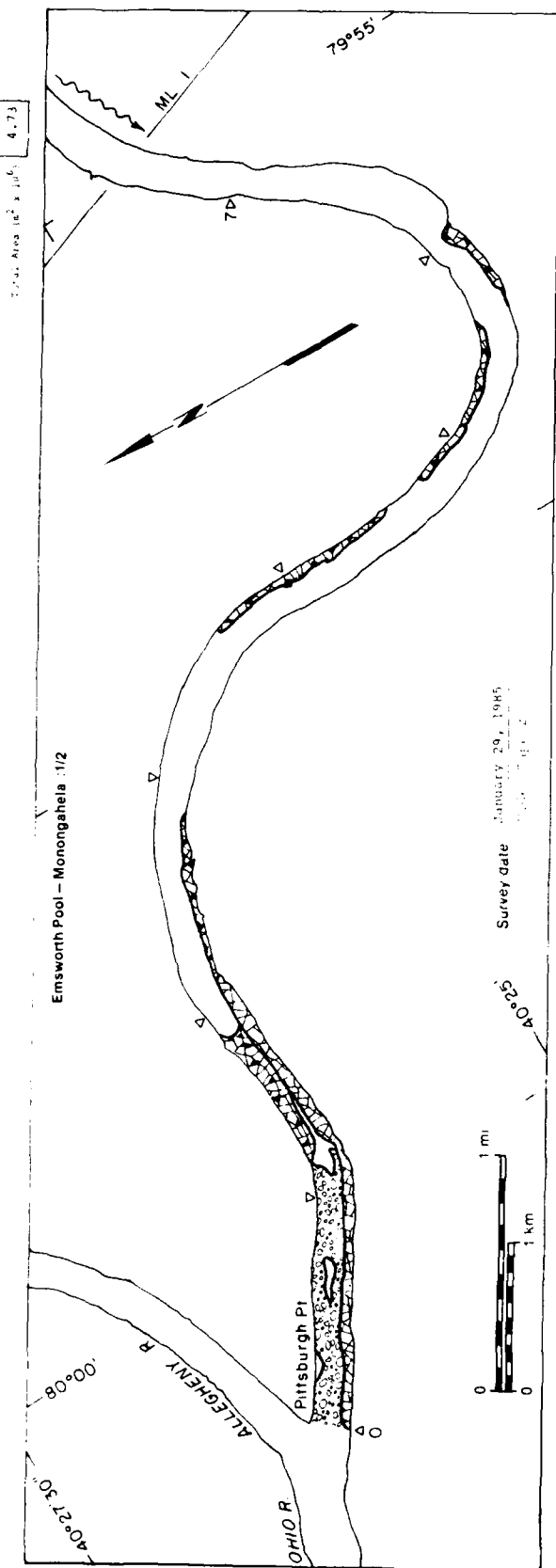
Emsworth Pool - Allegheny

Material	Area, $m^2 \times 10^6$	Surface concentration (g)
Open water	0.15	NA
Sand/gravel	0.09	NA
Solid material with open water areas	0.14	80
Fragmented ice cover	0.29	NA
Fragmented ice cover with open water areas	0.63	NA
Unfrozen ice cover	---	---
Total Area ($m^2 \times 10^6$)	3.27	

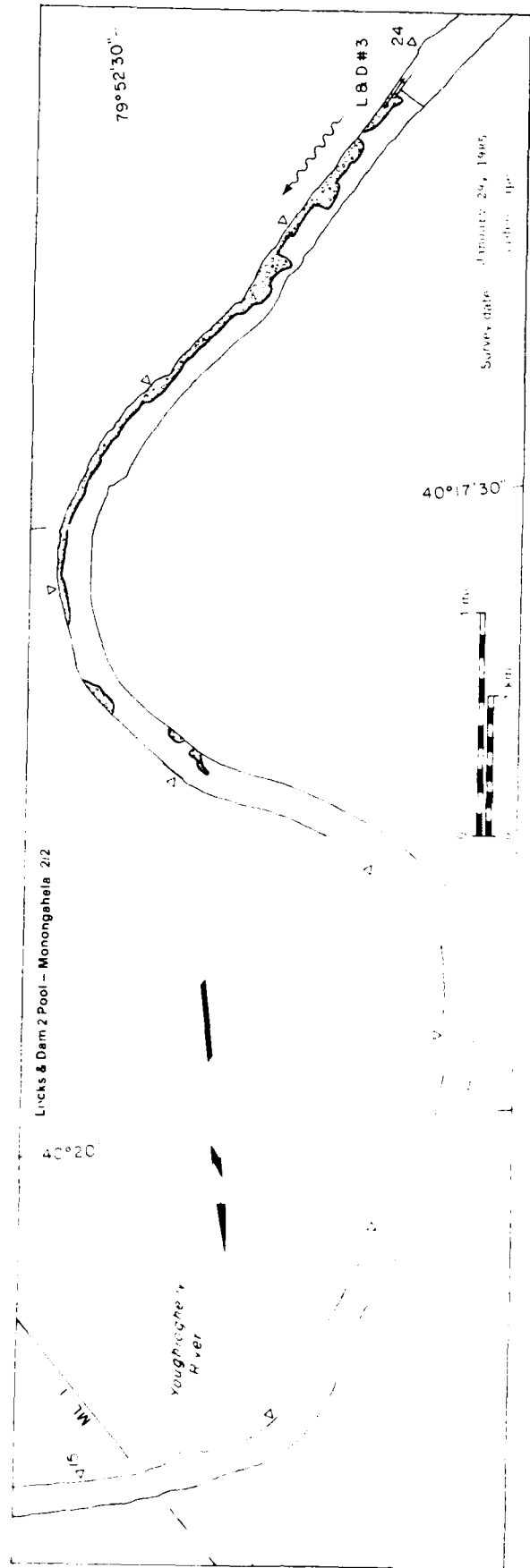
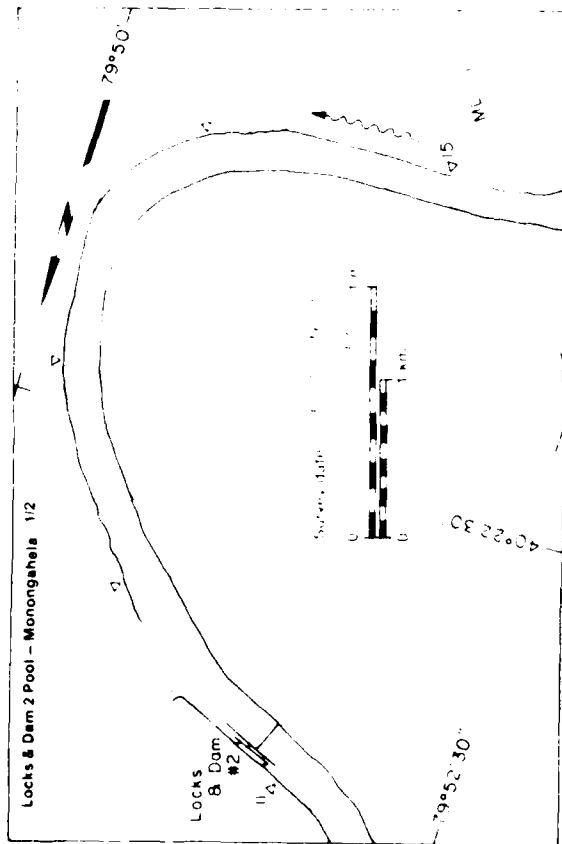
Emsworth Pool - Monongahela

Material	Area, $m^2 \times 10^6$	Surface concentration (g)
Open water	3.71	NA
Sand/gravel	---	NA
Solid material with open water areas	---	---
Fragmented ice cover	0.29	NA
Fragmented ice cover with open water areas	0.40	70
Unfrozen ice cover	0.33	45
Total Area ($m^2 \times 10^6$)	4.73	








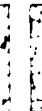
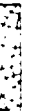


29 January 1985



Locks & Dam 2 Pool - Monongahela

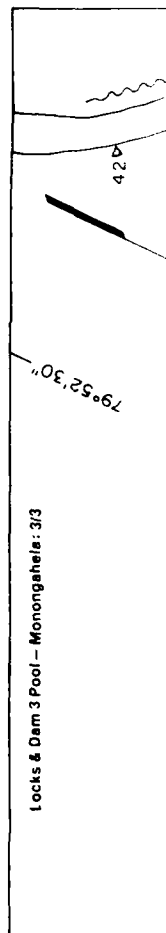
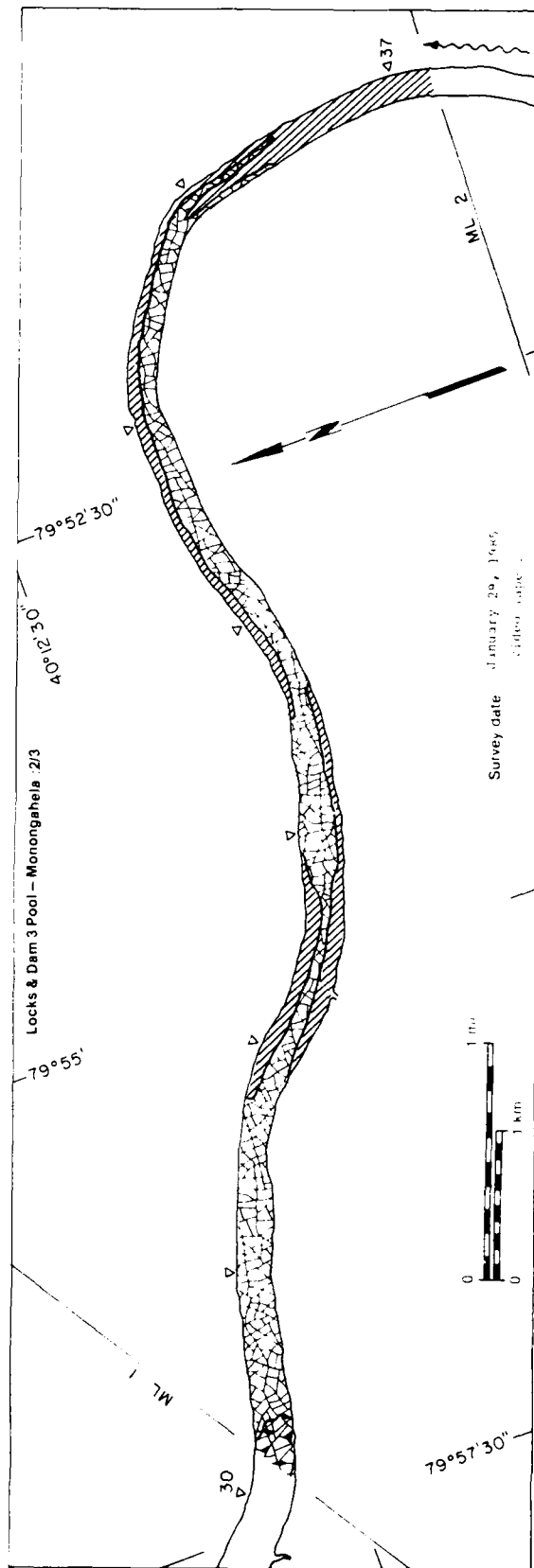
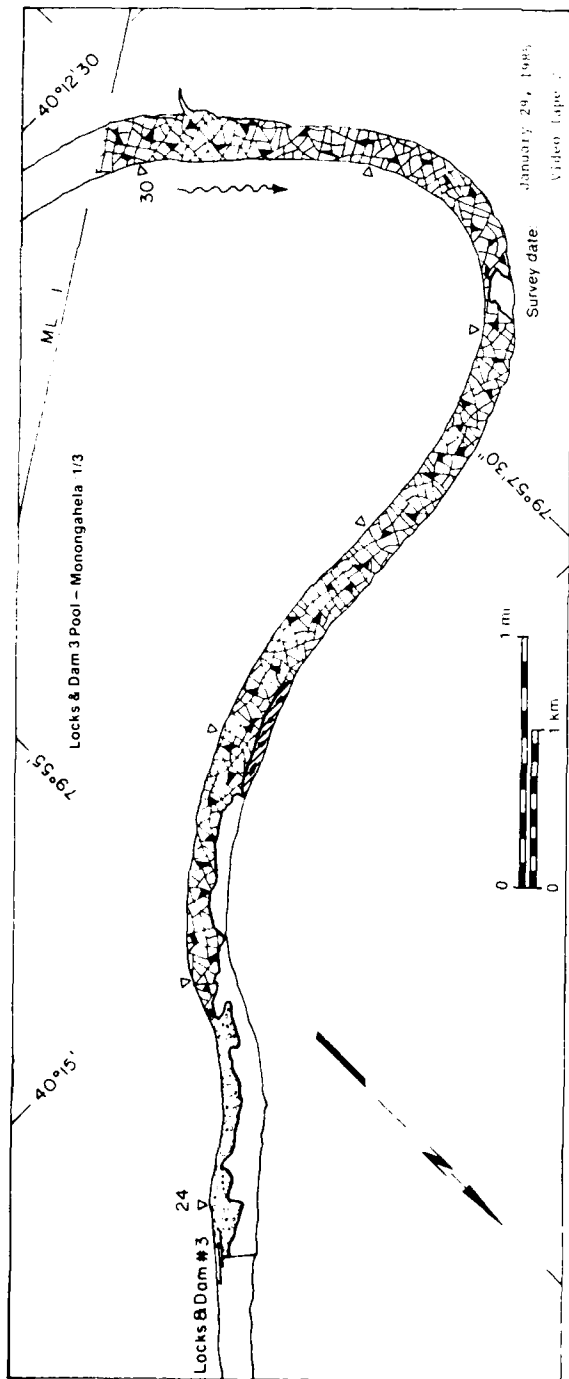
Locks & Dam 2 Pool - Monongahela

Map No. 1

	Water	NA
	Gravel	NA
	Gravel & Sand	NA
	Gravel & Sand & Gravel	NA
	Gravel & Sand & Gravel & Sand	NA
	Gravel & Sand & Gravel & Sand & Gravel	NA
	Gravel & Sand & Gravel & Sand & Gravel & Sand	NA

Scale 1" = 100'

29 January 1985



Locks & Dam 3 Pool - Monongahela

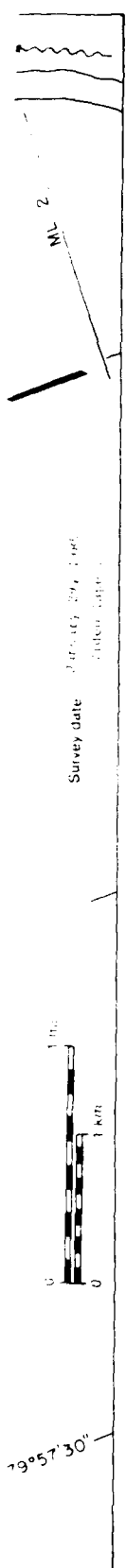
Surface concentration (m² x 10⁶)

MAP UNITS

1:42

1:42

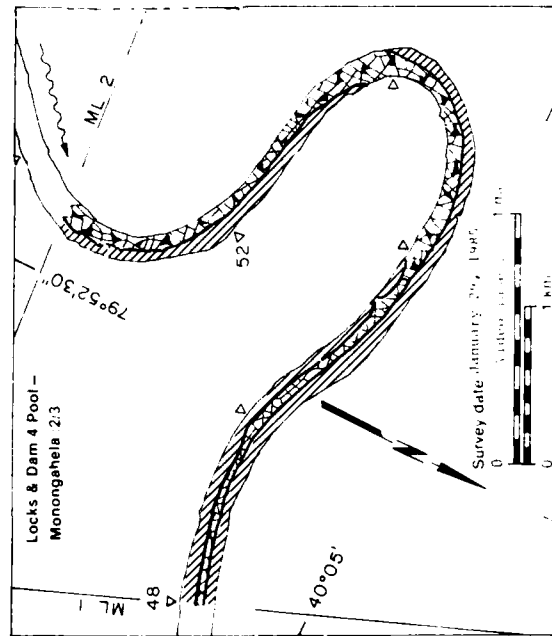
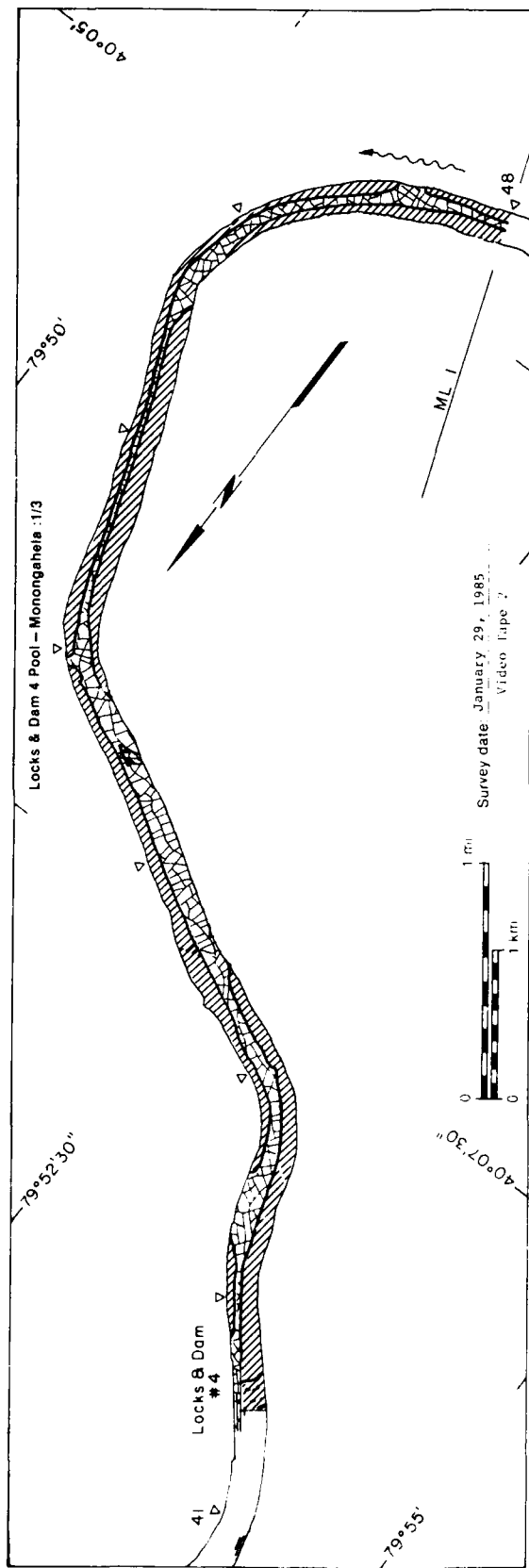
1:42



Locks & Dam 3 Pool - Monongahela

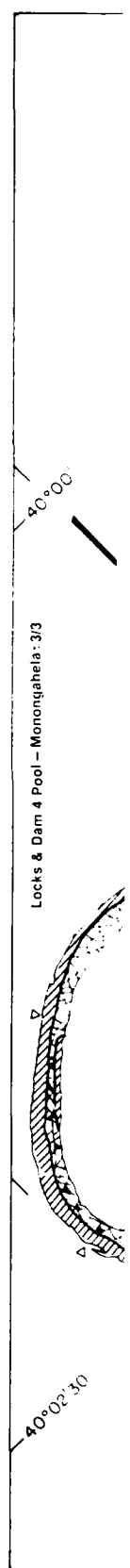
MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	0.44	NA
Solid ice cover	1.76	NA
Solid ice cover with open-water areas	0.06	90
Fragmented ice cover	2.15	NA
Fragmented ice cover with open-water areas	2.04	90
Ice floes or frazil slush and pans	0.19	30
Total Area (m² x 10⁶)	6.64	

29 January 1985



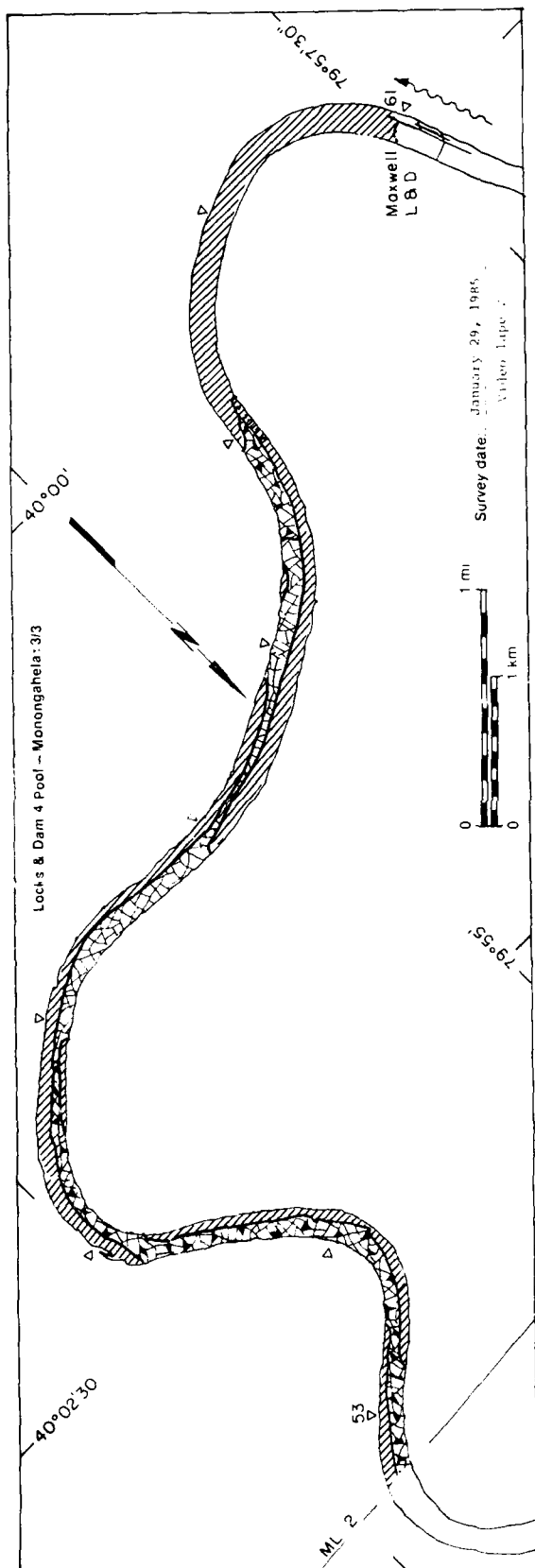
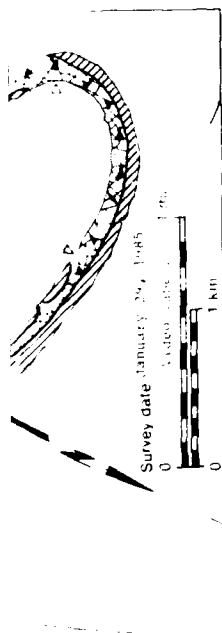
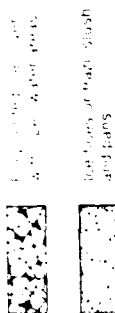
Locks & Dam 4 Pool - Monongahela

MAP UNITS		Surface concentration (%)
Symbol	Area (m ² x 10 ⁶)	
Open water	0.08	NA
Solid ice cover	3.71	NA
Solid ice cover with open water areas	0.08	60
Fragmented ice cover	1.63	NA
Fragmented ice cover with open water areas	1.10	95
Ice floes of 1 m ² or less	---	---
Total Area (m ² x 10 ⁶)		6.60

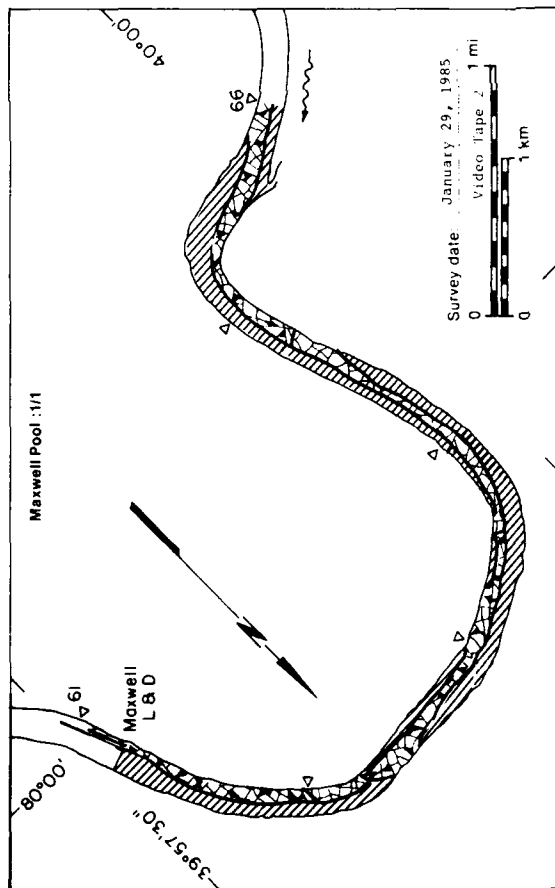


45	---	---
---	---	---
6.60	---	---

Total Area ($m^2 \times 10^6$)

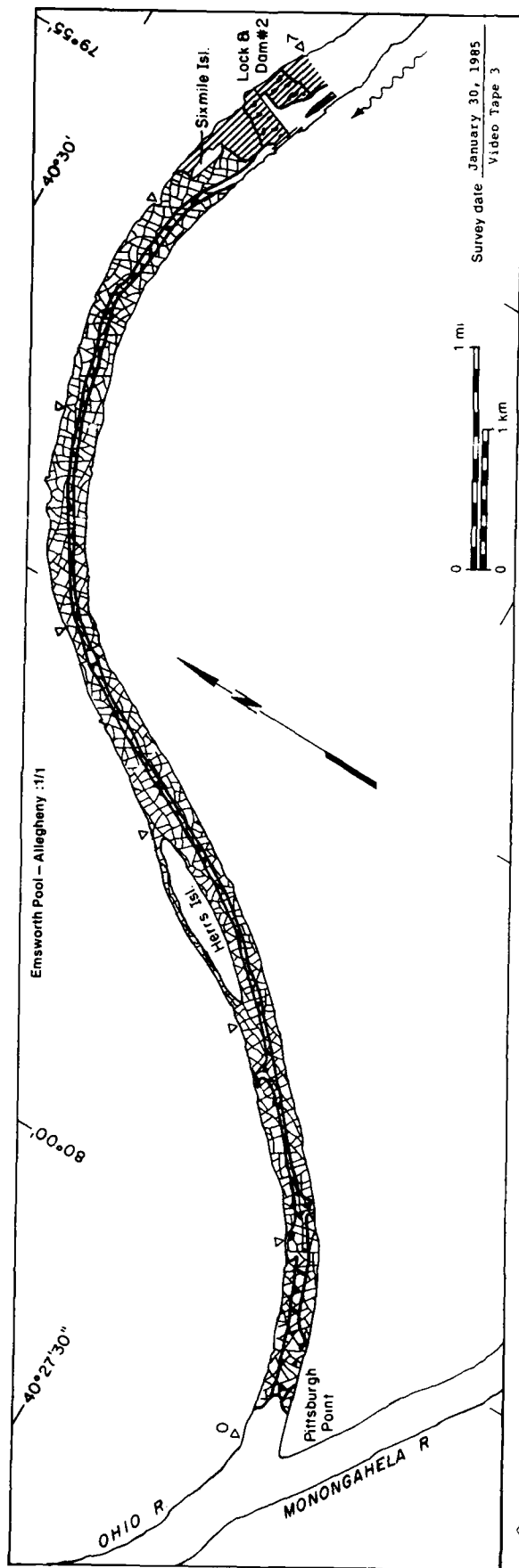


29 January 1985



Maxwell Pool MAP UNITS	Area ($m^2 \times 10^6$)	Surface concentration (%)
Open water	—	NA
Solid ice cover	0.95	NA
Solid ice cover with open water areas	—	—
Fragmented ice cover	0.17	NA
Fragmented ice cover with open water areas	0.44	95
Ice floes or frazil slush and pans	—	—
Total Area ($m^2 \times 10^6$)	1.56	

30 January 1985

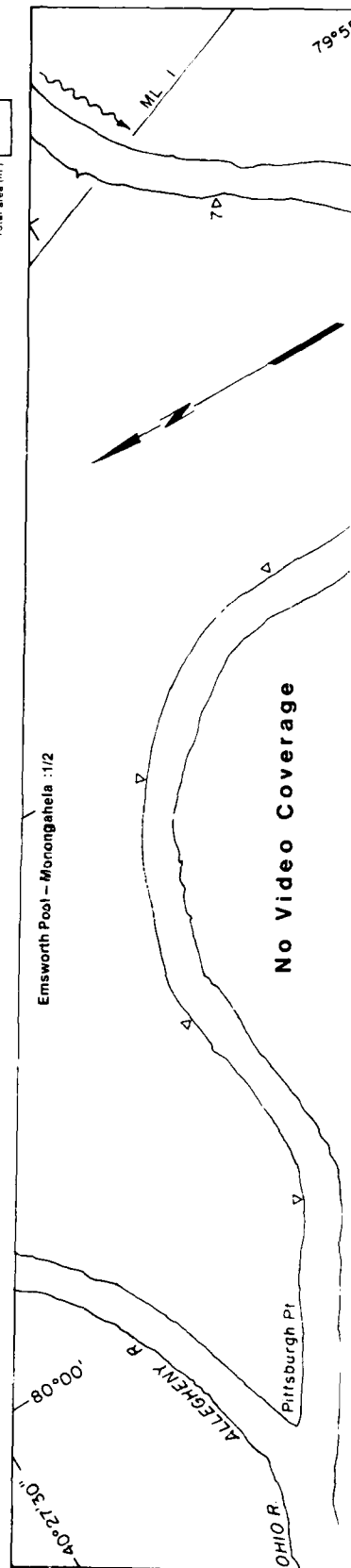


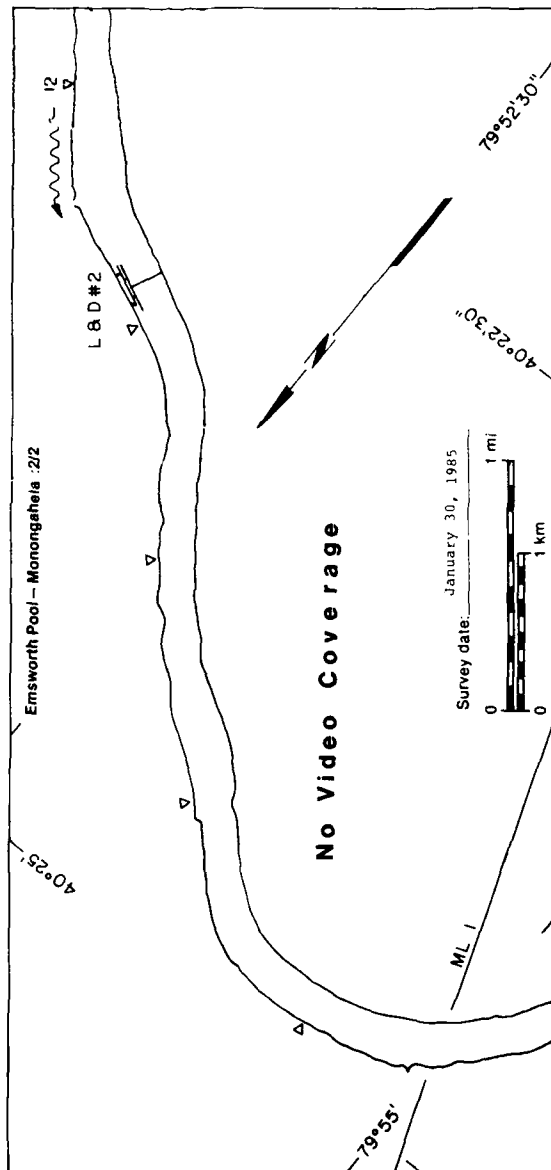
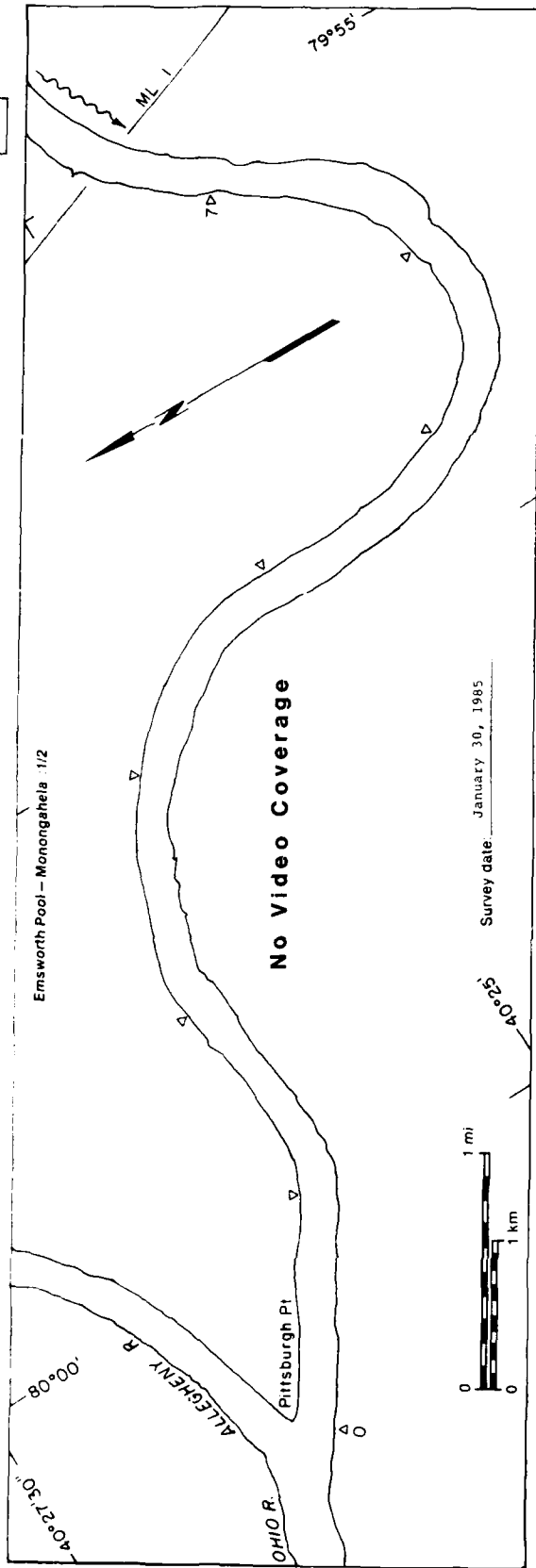
➤ Emsworth Pool - Allegheny

MAP UNITS	Surface Concentration (kg)
Open water	0.23
Solid ice cover	0.18
Solid ice cover with open water areas	0.14
Fragmented ice cover	2.13
Fragmented ice cover with open water areas	0.58
Ice floes or trash slush and pens	0.01
Total Area (m ² x 10 ⁶)	3.27

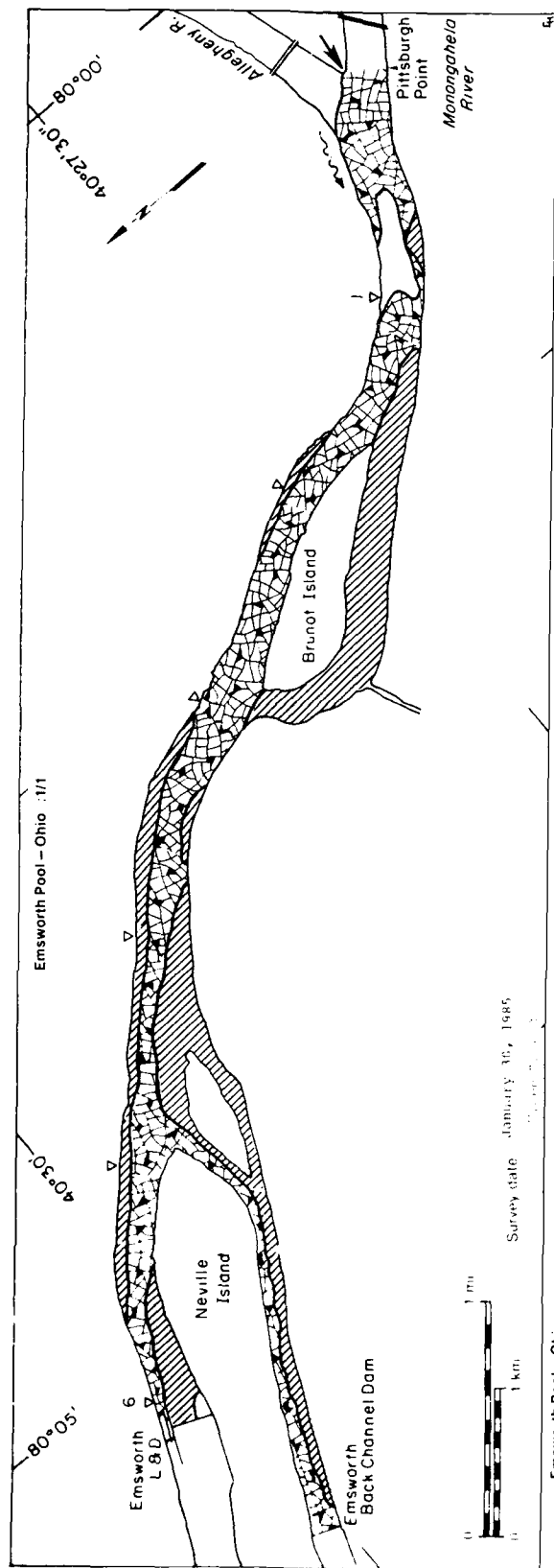
➤ Emsworth Pool - Monongahela

MAP UNITS	Area (m ²)	Surface Concentration (kg)
Open water		NA
Solid ice cover		NA
Solid ice cover with open water areas		NA
Fragmented ice cover		NA
Fragmented ice cover with open water areas		NA
Ice floes or trash slush and pens		NA
Total area (m ²)		





30 January 1985



Emsworth Pool - Ohio

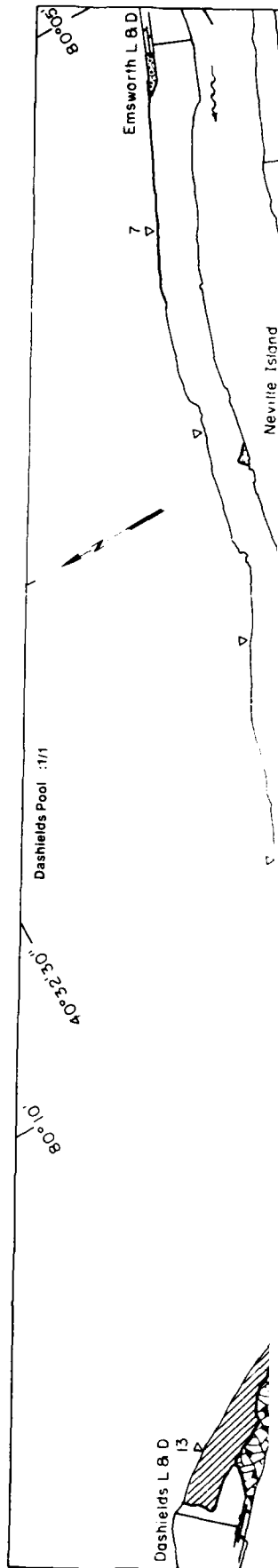
Surface concentration
($\text{m}^2 \times 10^6$)

0.28	NA
1.74	NA
---	---
---	NA
2.42	80
---	---
4.46	

MAP UNITS

- Open water
- Solid ice cover
- Solid ice cover with open water areas
- Fragmented ice cover
- Fragmented ice cover with open water areas
- Ice floes or frazil slush and pans

Total Area ($\text{m}^2 \times 10^6$)



Dashields Pool - Ohio

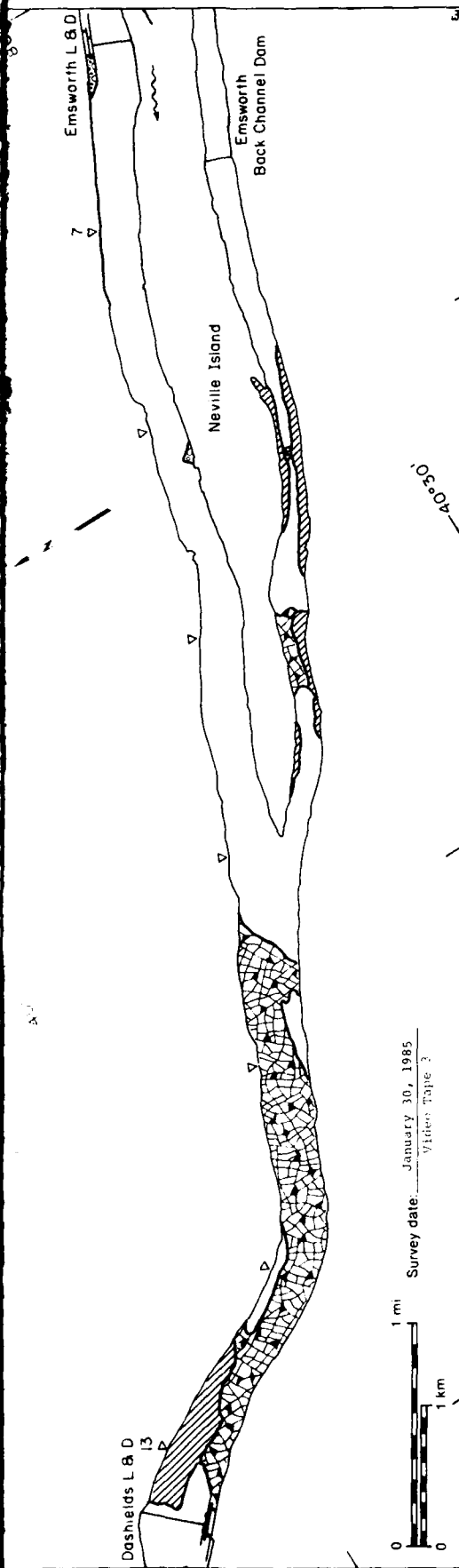
Surface concentration
($\text{m}^2 \times 10^6$)

0.28	NA
1.74	NA
---	---
---	NA
2.42	80
---	---
4.46	

MAP UNITS

- Open water
- Solid ice cover
- Solid ice cover with open water areas
- Fragmented ice cover
- Fragmented ice cover with open water areas
- Ice floes or frazil slush and pans

Total Area ($\text{m}^2 \times 10^6$)

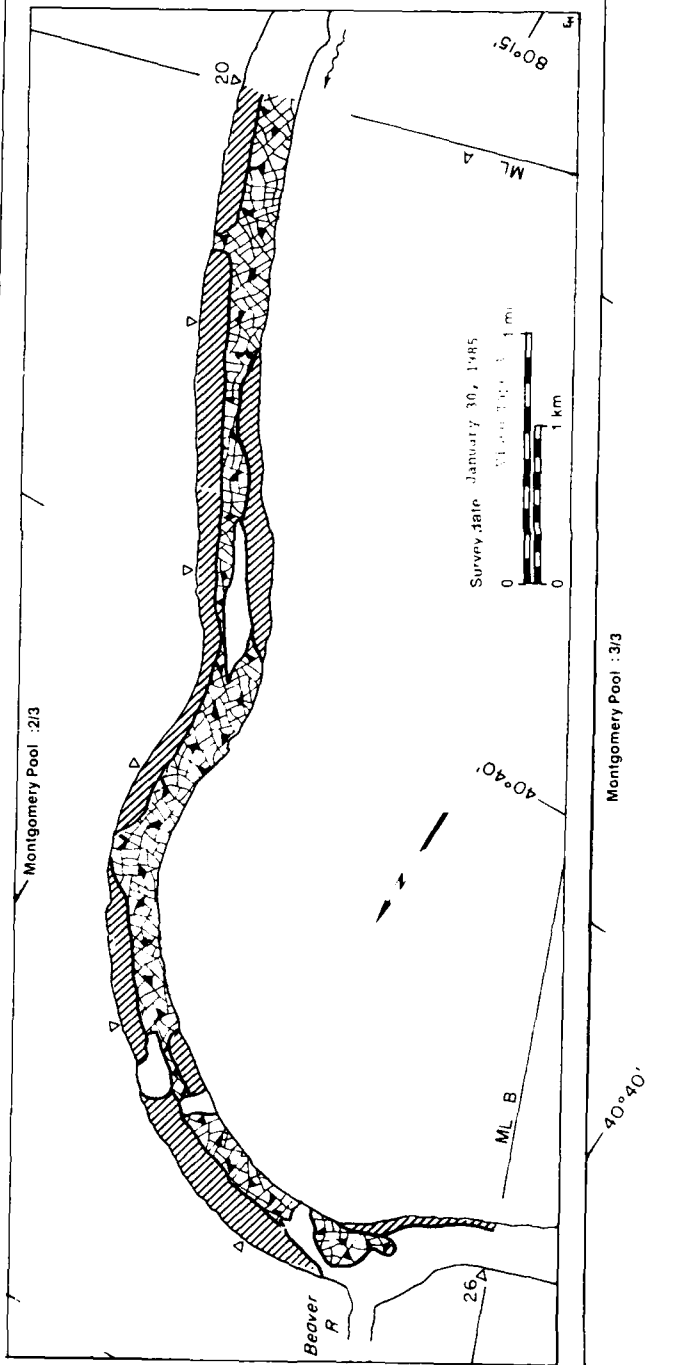
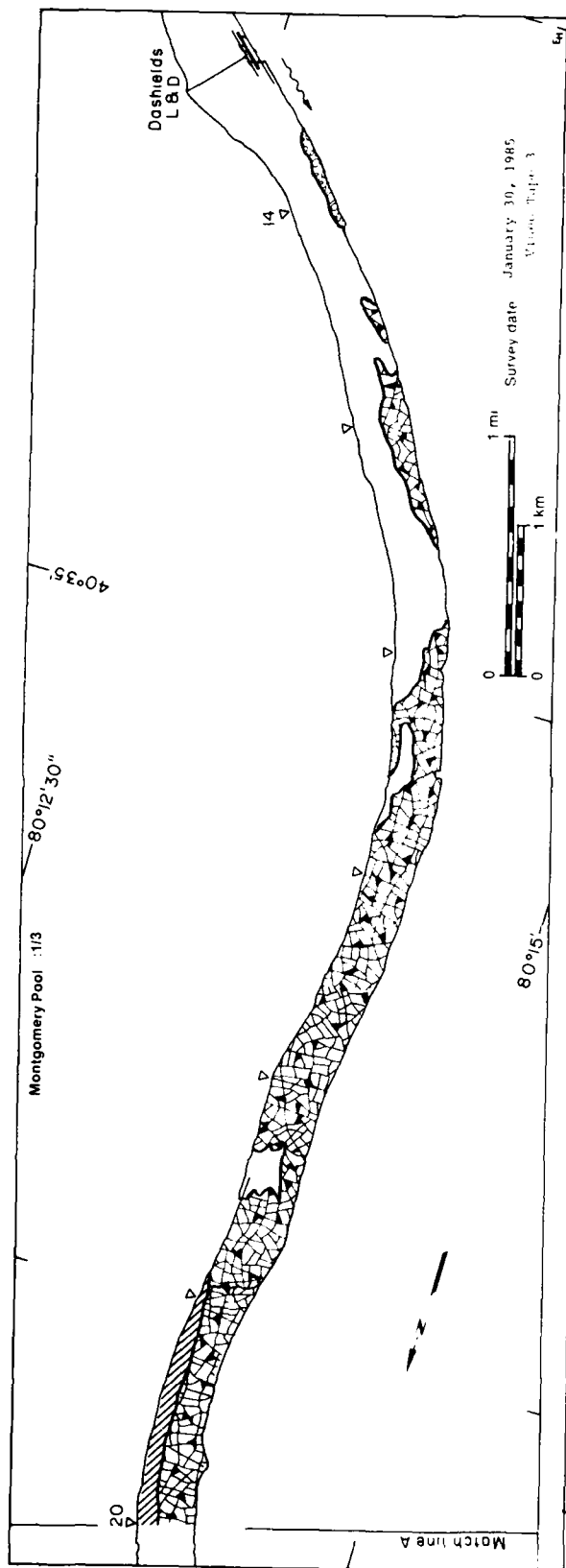


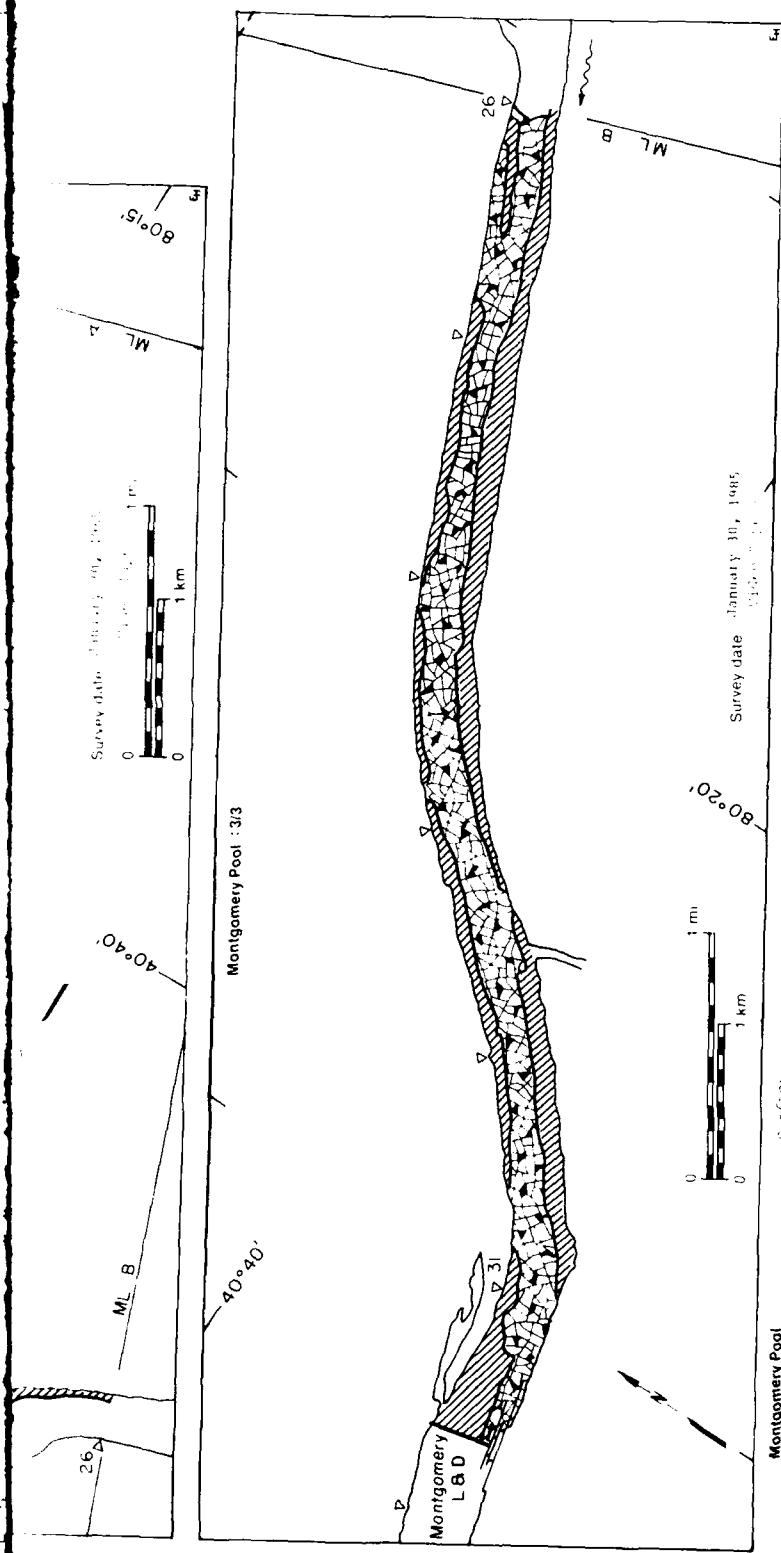
Survey date: January 30, 1985
Video Tape 3

Dashed Pool

MAP UNITS	Area ($m^2 \times 10^6$)	Surface concentration (%)
Open water	3.15	NA
Solid ice cover	0.47	NA
Solid ice cover with open-water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	1.34	70
Ice floes or frazil slush and pans	0.04	20
Total Area ($m^2 \times 10^6$)	5.00	

30 January 1985



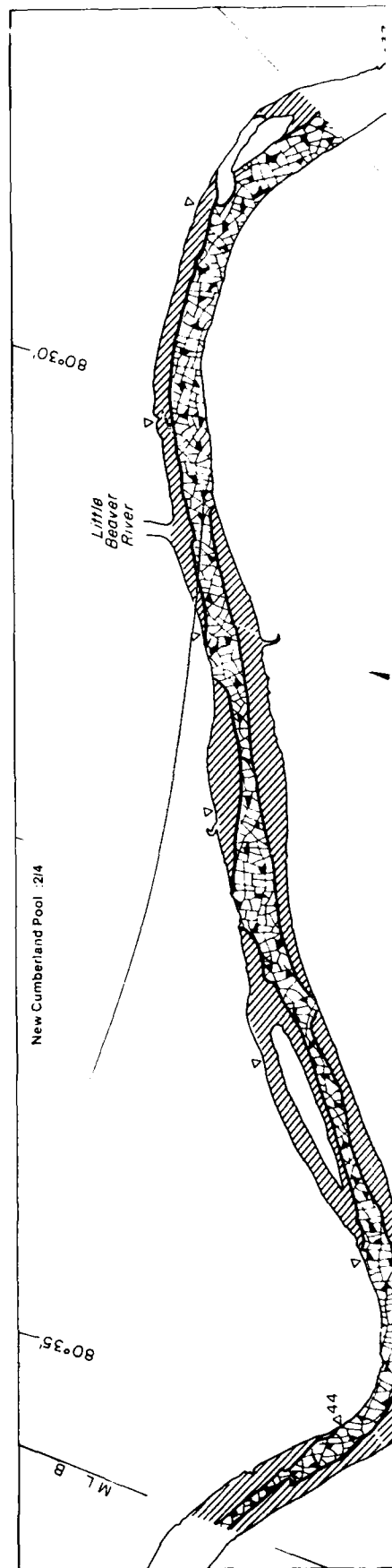
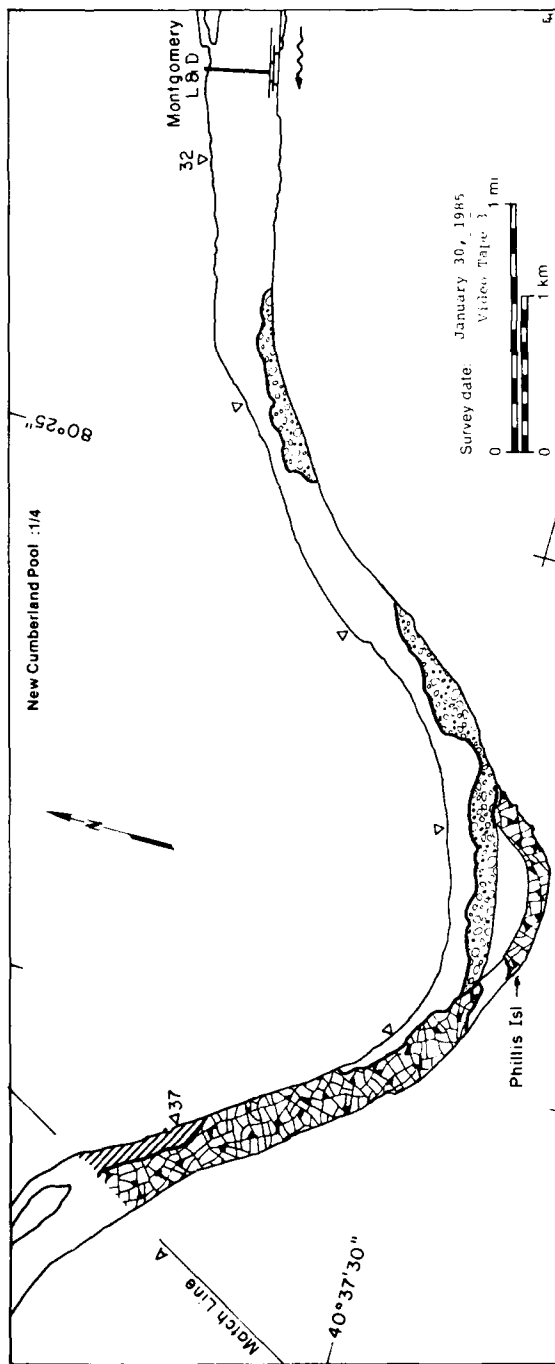


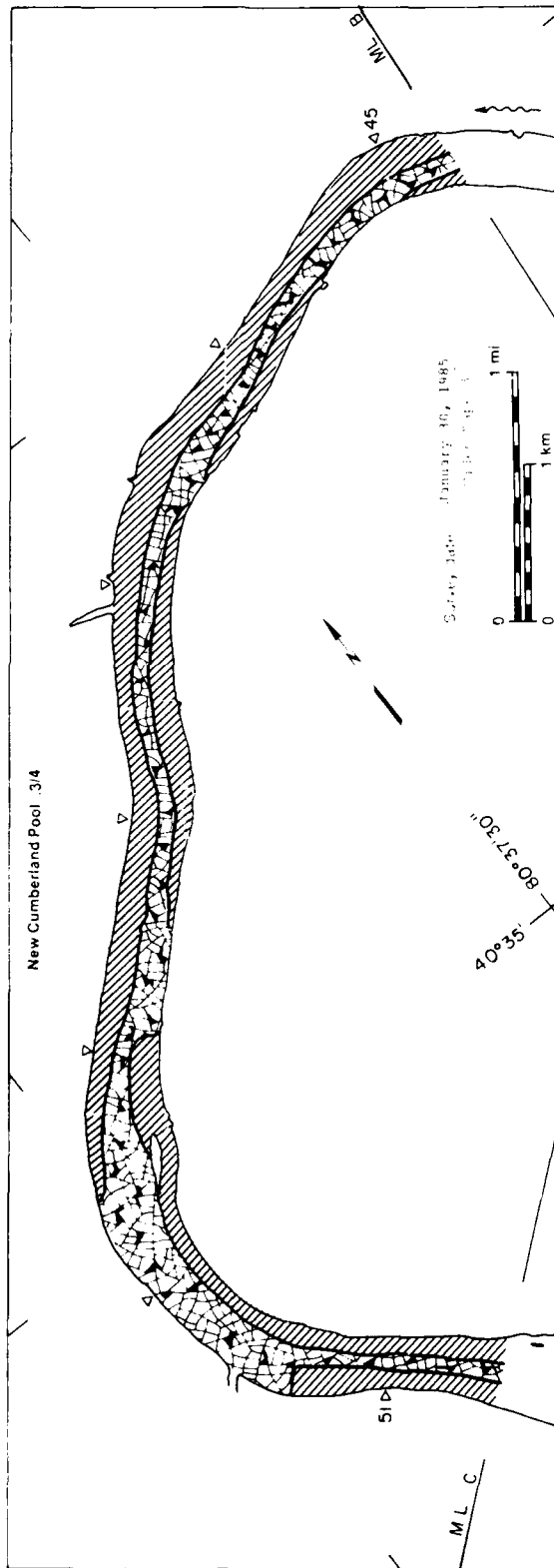
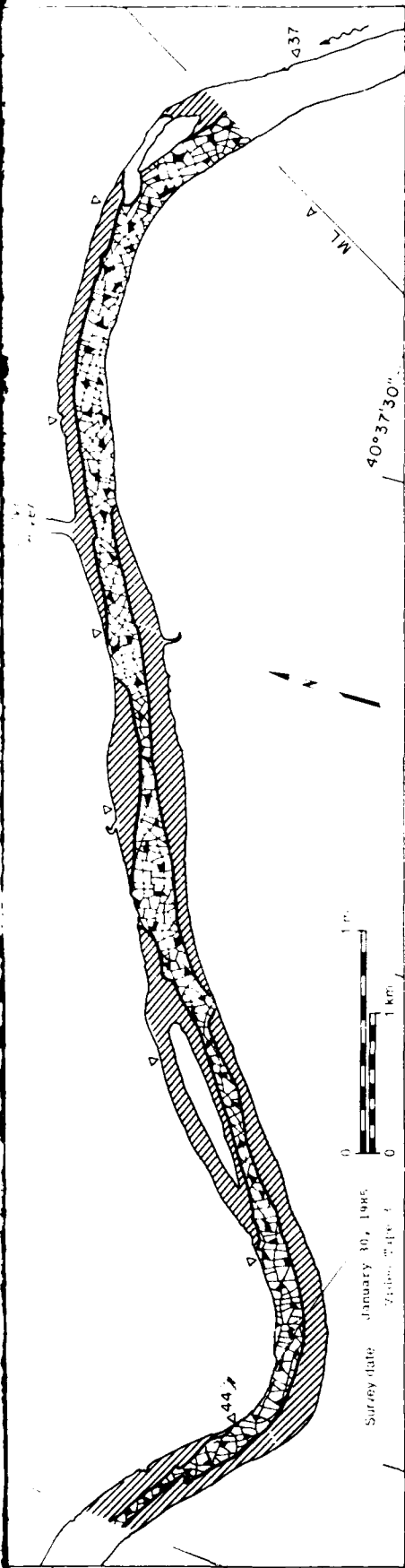
Survey date January 30, 1985

Montgomery Pool

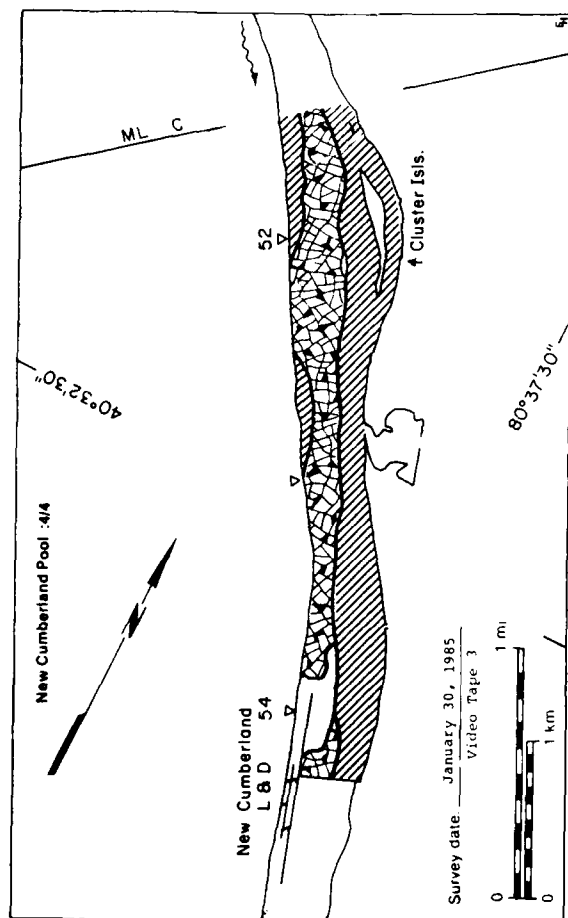
MAP UNITS	Area $(m^2 \times 10^6)$	Surface concentration (%)
Open water	2.13	NA
Solid ice cover	3.39	NA
Solid ice cover with open water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open water areas	5.71	75
Ice floes or frazil slush and pans	0.04	10
Total area $(m^2 \times 10^6)$		11.27

30 January 1985



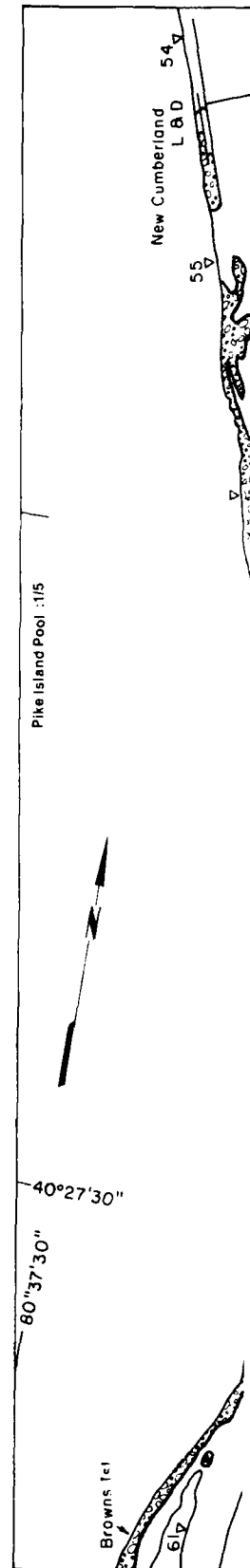


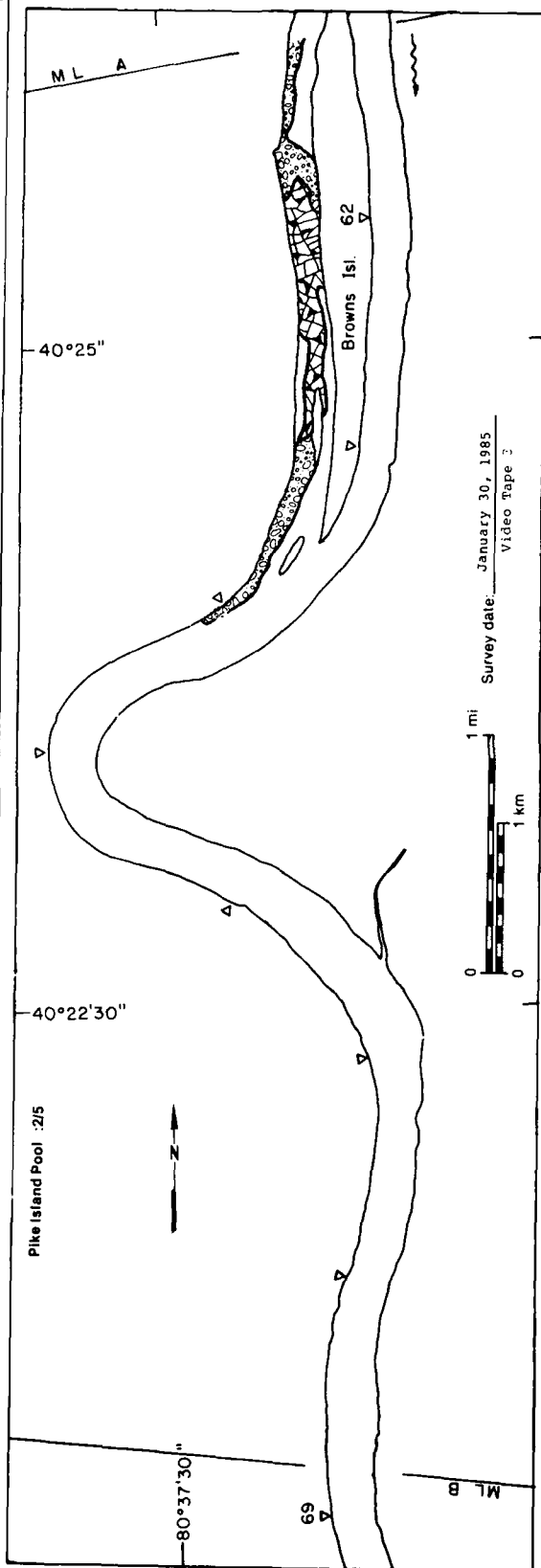
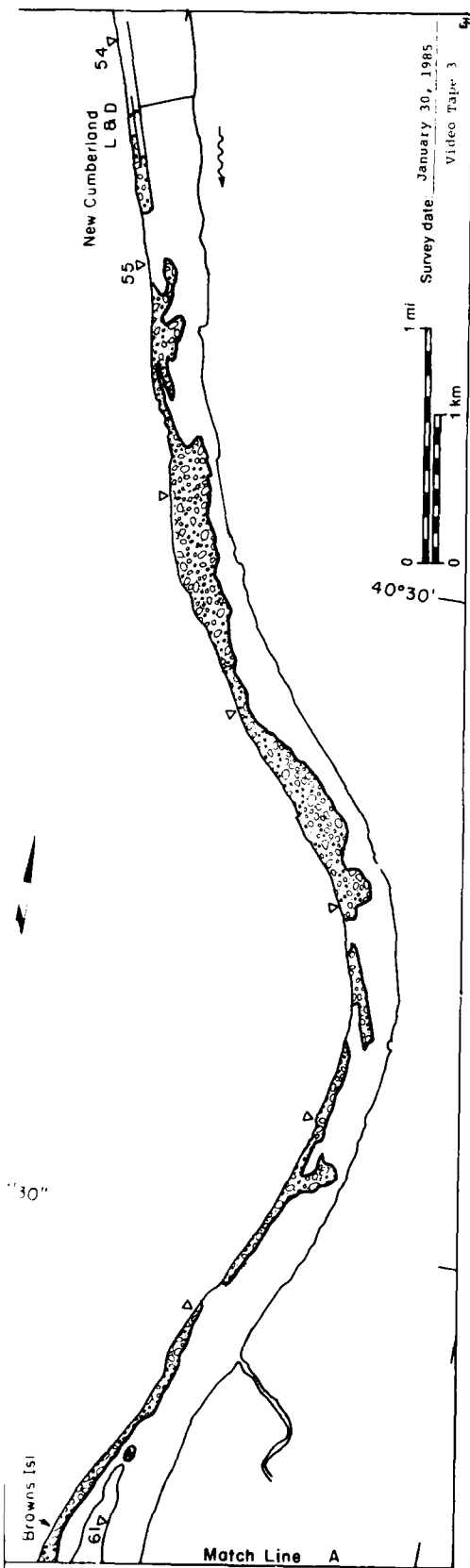
30 January 1985



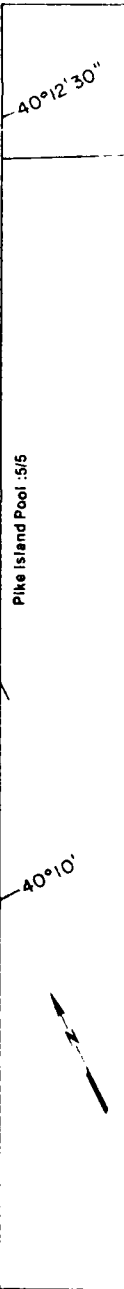
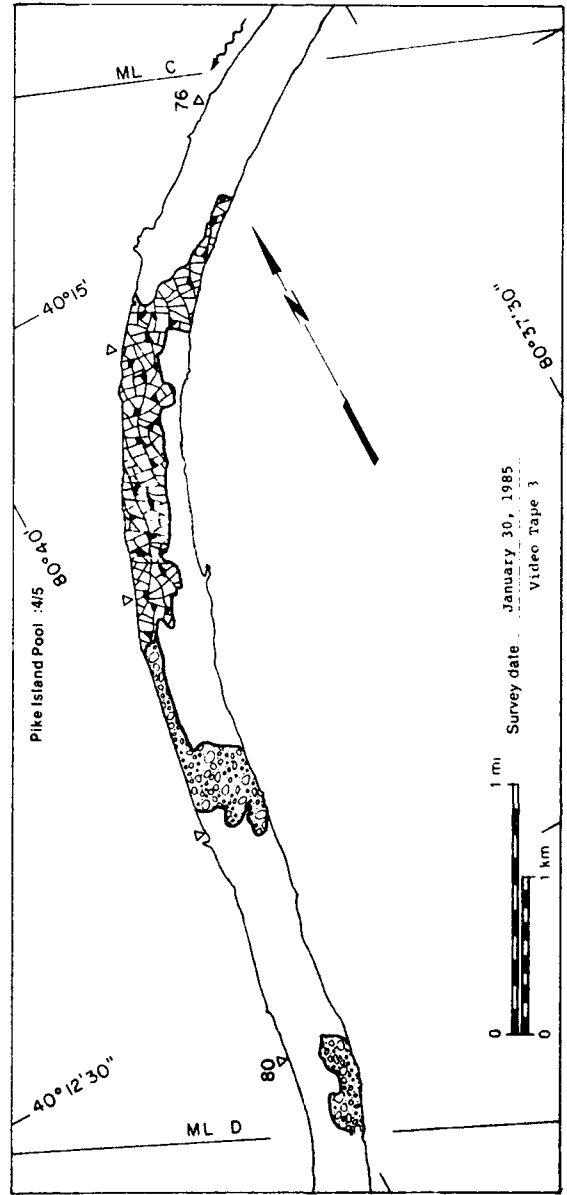
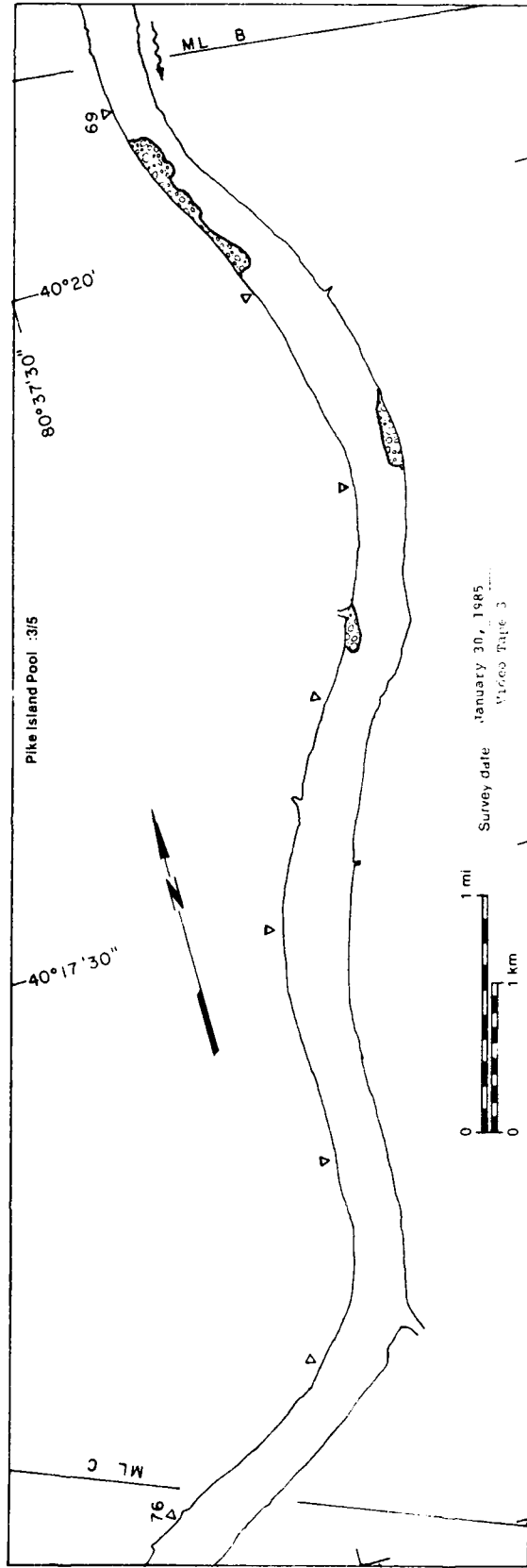
New Cumberland Pool

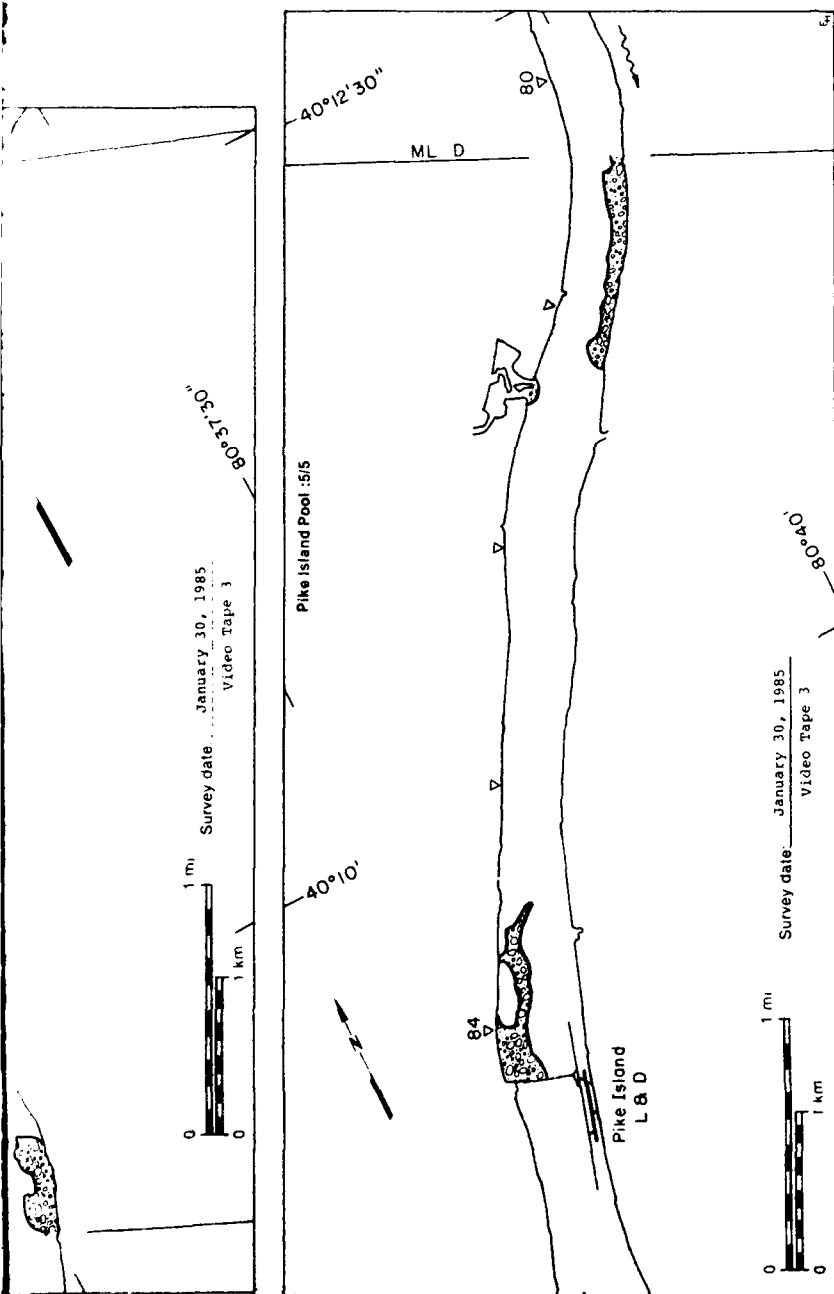
MAP UNITS	Area, a_i ($m^2 \times 10^6$)	Surface concentration (%)
Open water	2.01	NA
Solid ice cover	6.55	NA
Solid ice cover with open-water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	5.82	70
Ice floes or frazil slush and pans	0.49	5
Total Area ($m^2 \times 10^6$)	14.87	





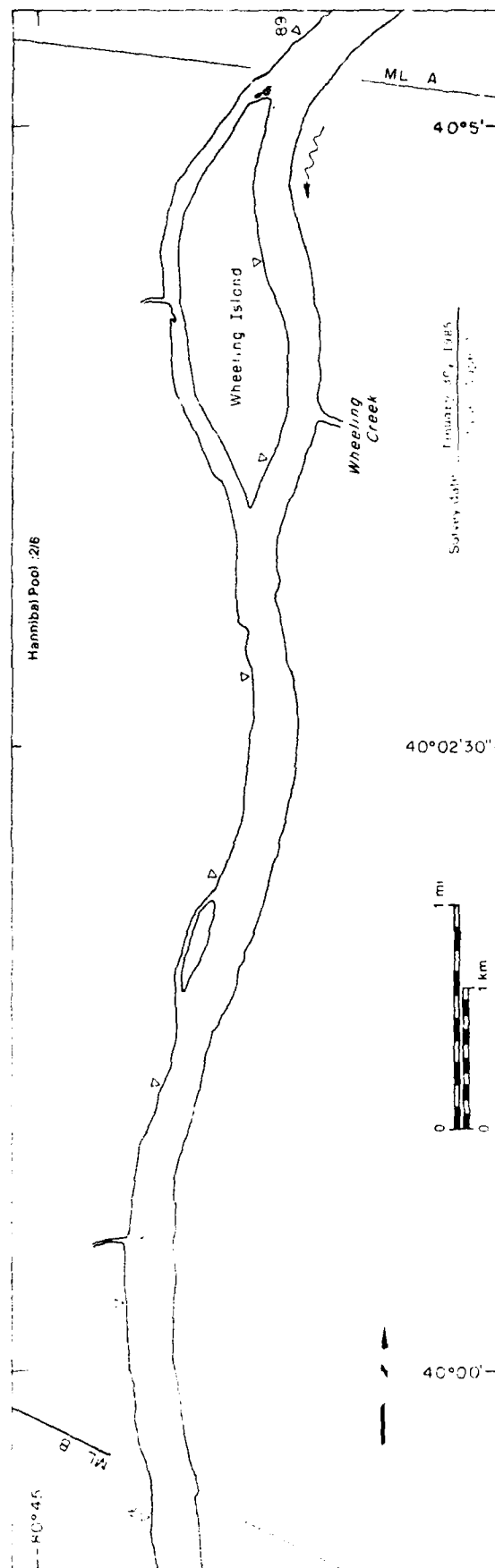
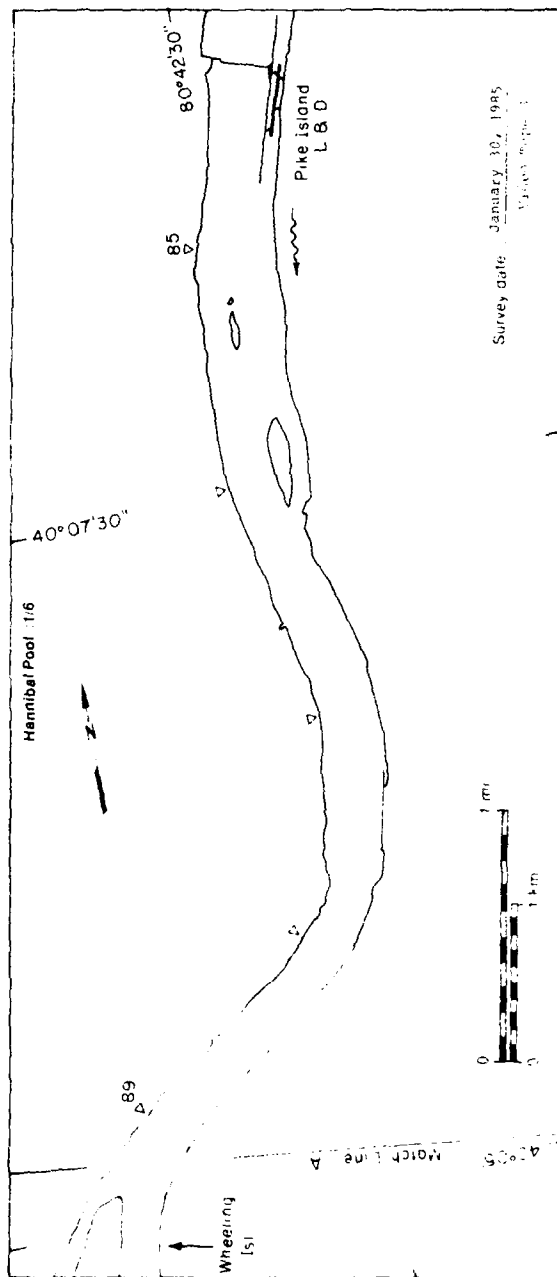
30 January 1985



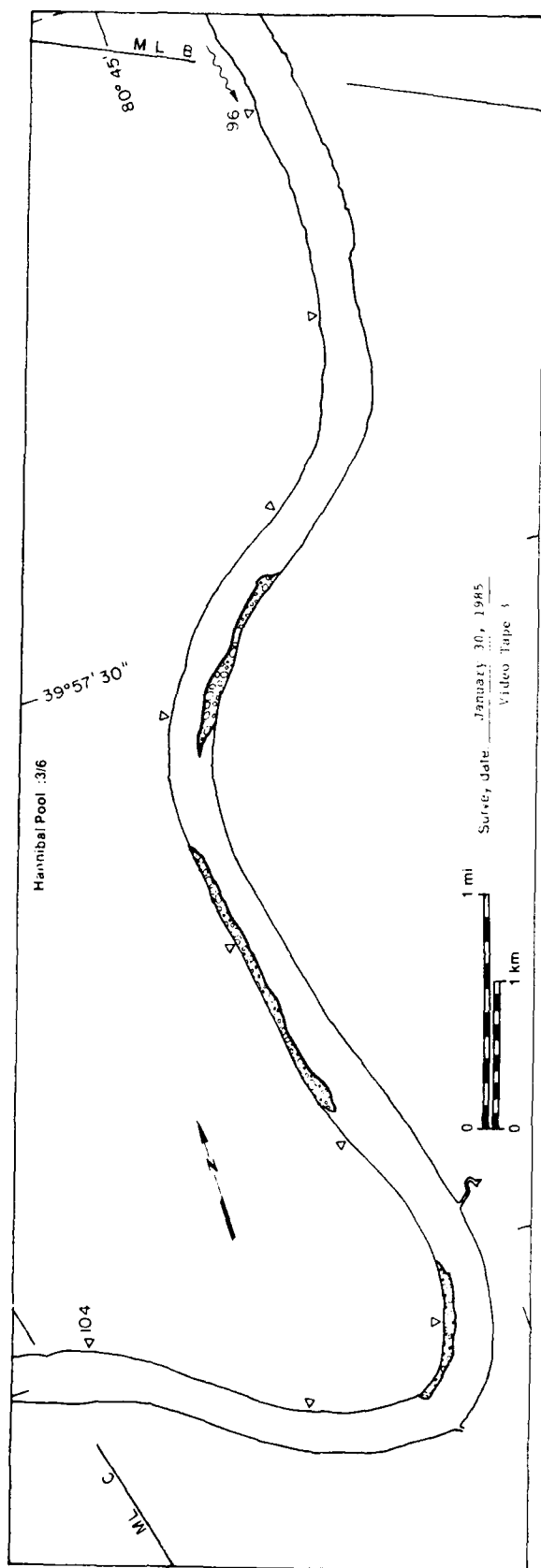
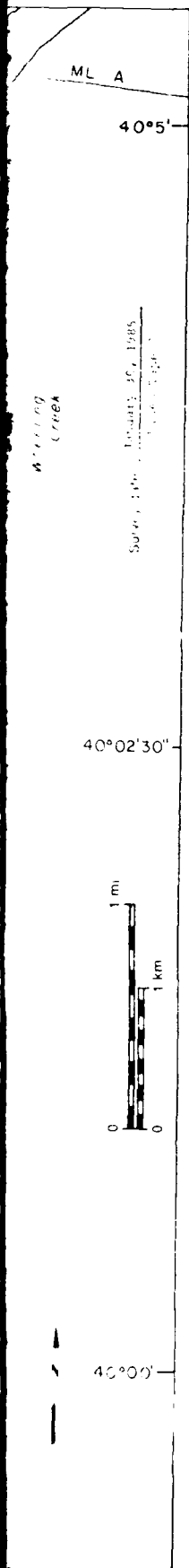


Pike Island Pool		Area	Surface
MAP UNITS		(m ² x 10 ⁶)	concentration (%)
	Open water	15.64	NA
	Solid ice cover	--	NA
	Solid ice cover with open-water areas	--	--
	Fragmented ice cover	--	NA
	Fragmented ice cover with open-water areas	1.00	50
	Ice floes or frazil slush and pans	2.28	5
Total Area (m ² x 10 ⁶)		18.92	

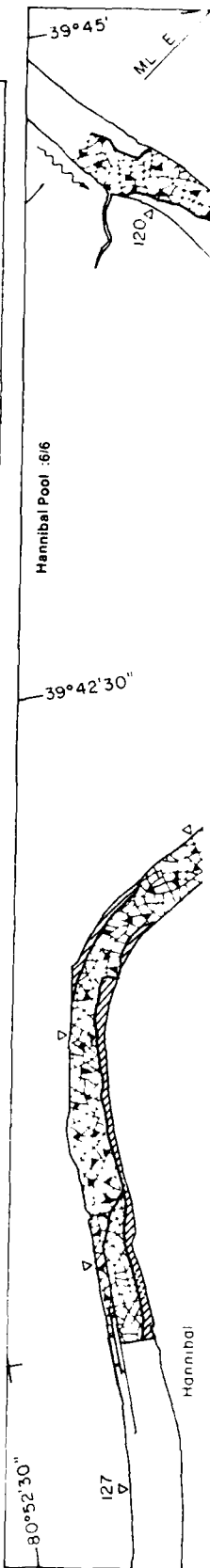
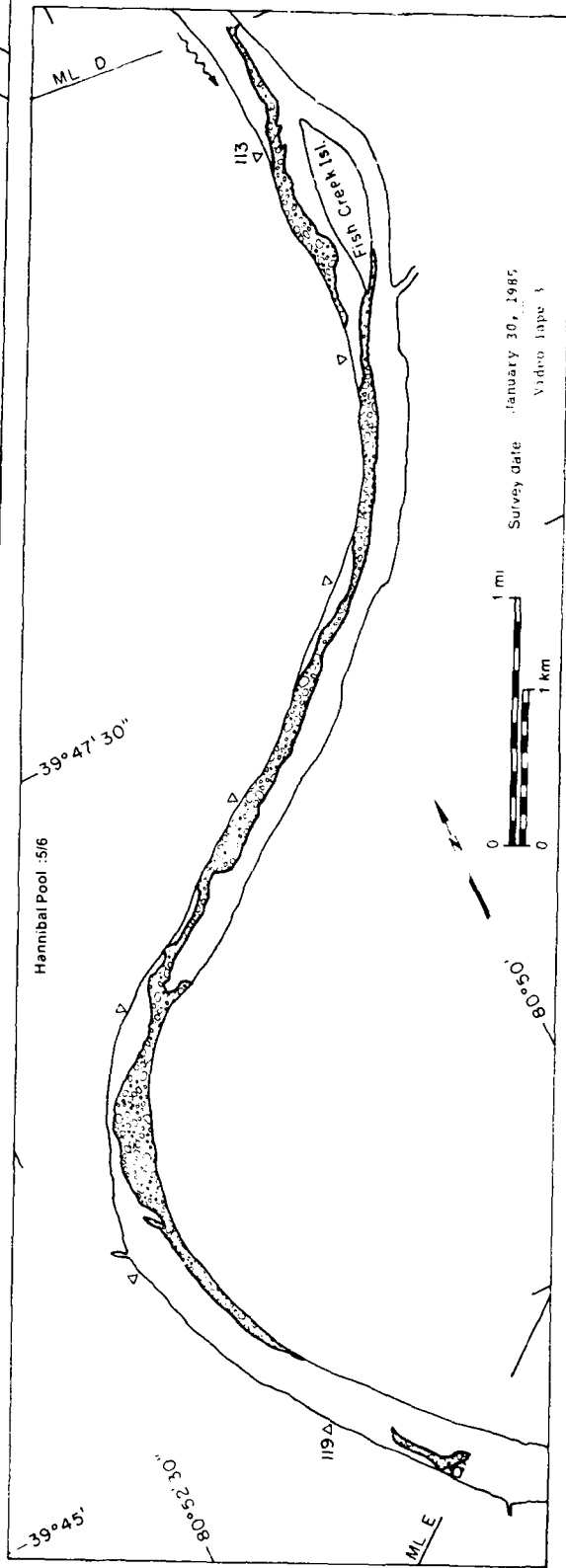
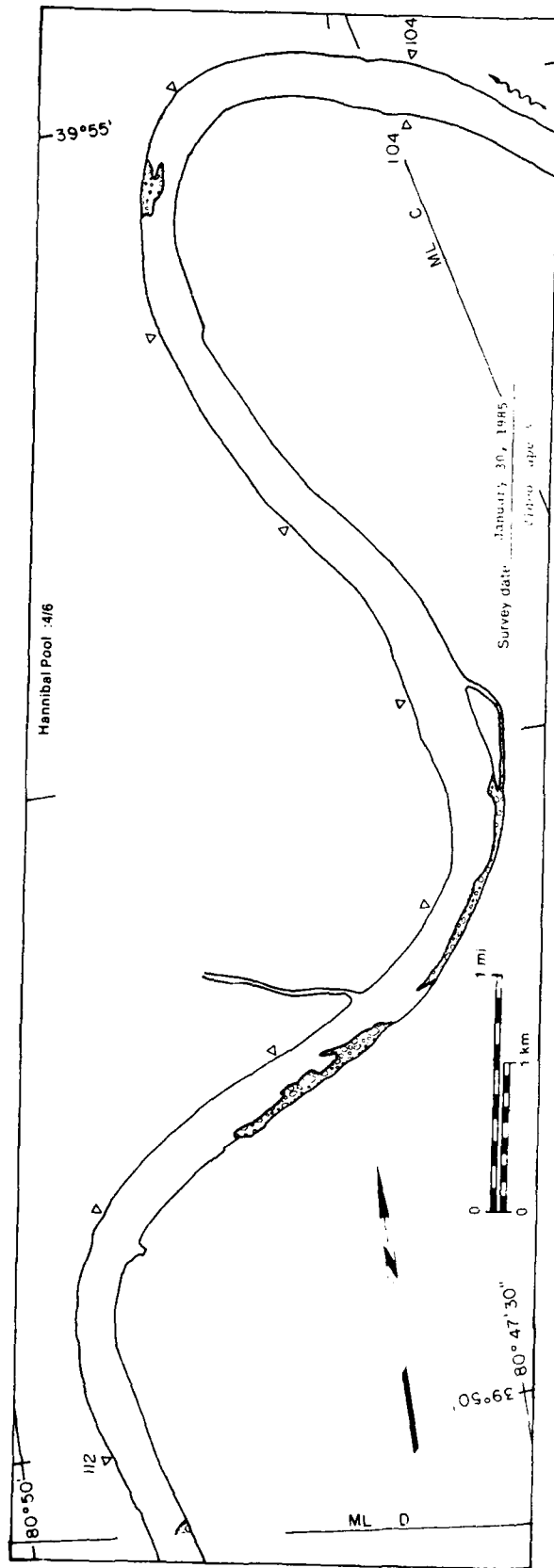
30 January 1985

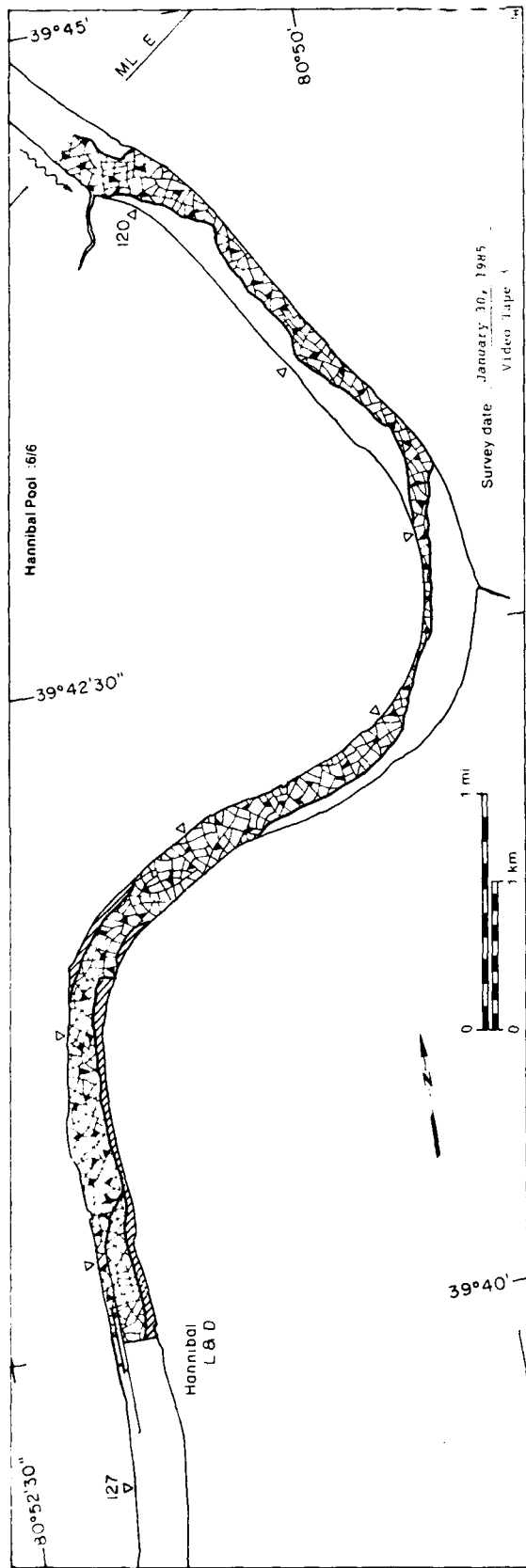


Hannibal Pool 3/6



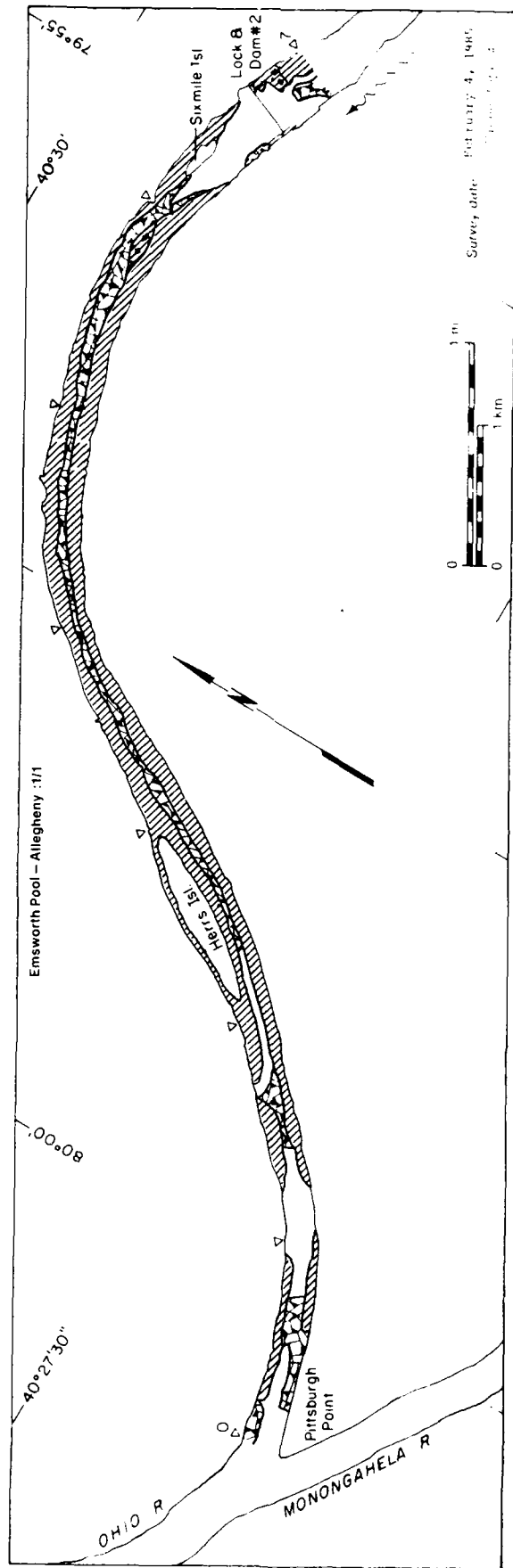
30 January 1985





Hannibal Pool	Area (m ²)	Surface elevation (m)
127	18.10	1.24
120	0.24	1.24
121	0.17	1.24
122	1.91	1.24
123	1.65	1.24
Total Area (m ²)	22.07	

4 February 1985



Emsworth Pool - Allegheny

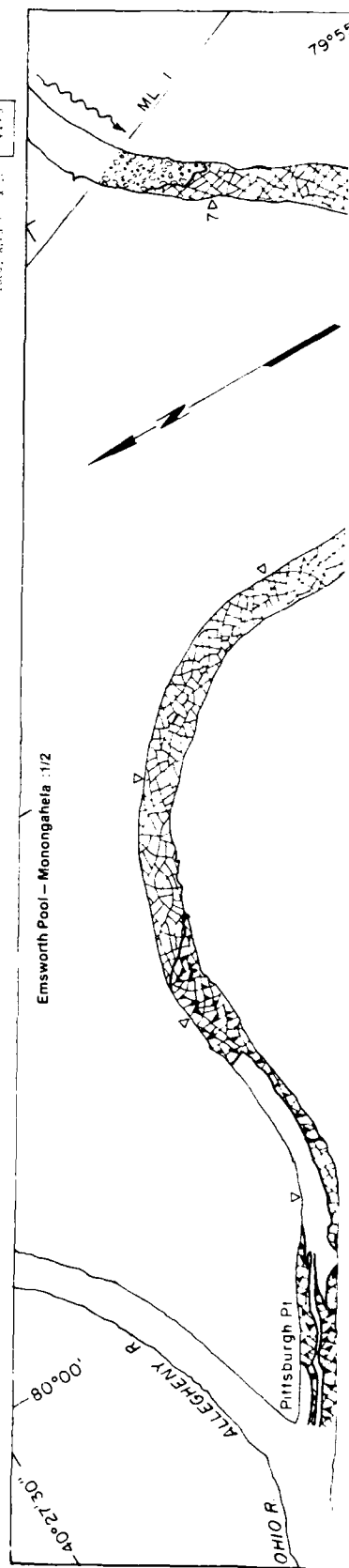
Area (sq. ft.)	Area (sq. ft.)
0.65	95
1.95	60
0.07	5
0.59	
0.01	
3.27	

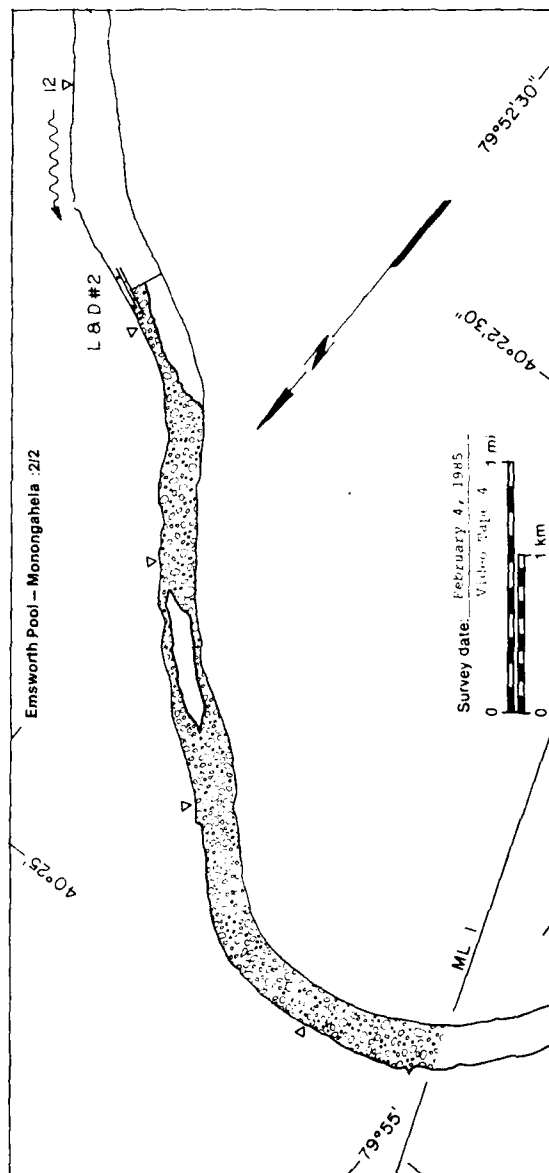
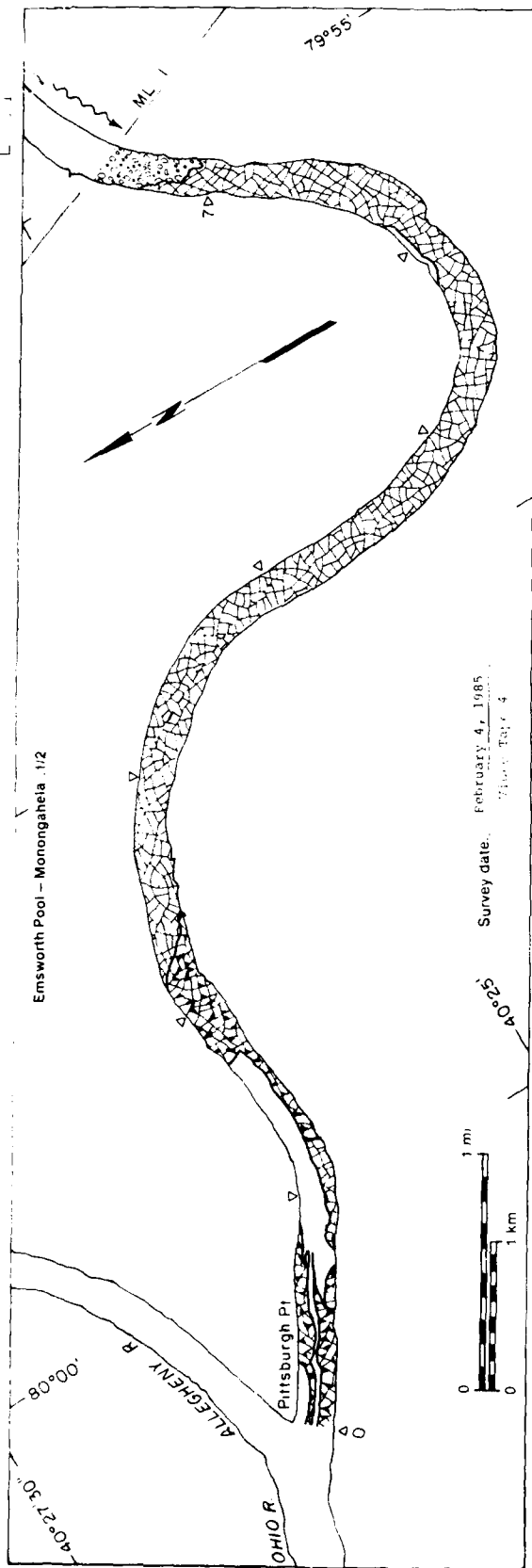
Total Area (sq. ft.) = 3.27

Emsworth Pool - Monongahela

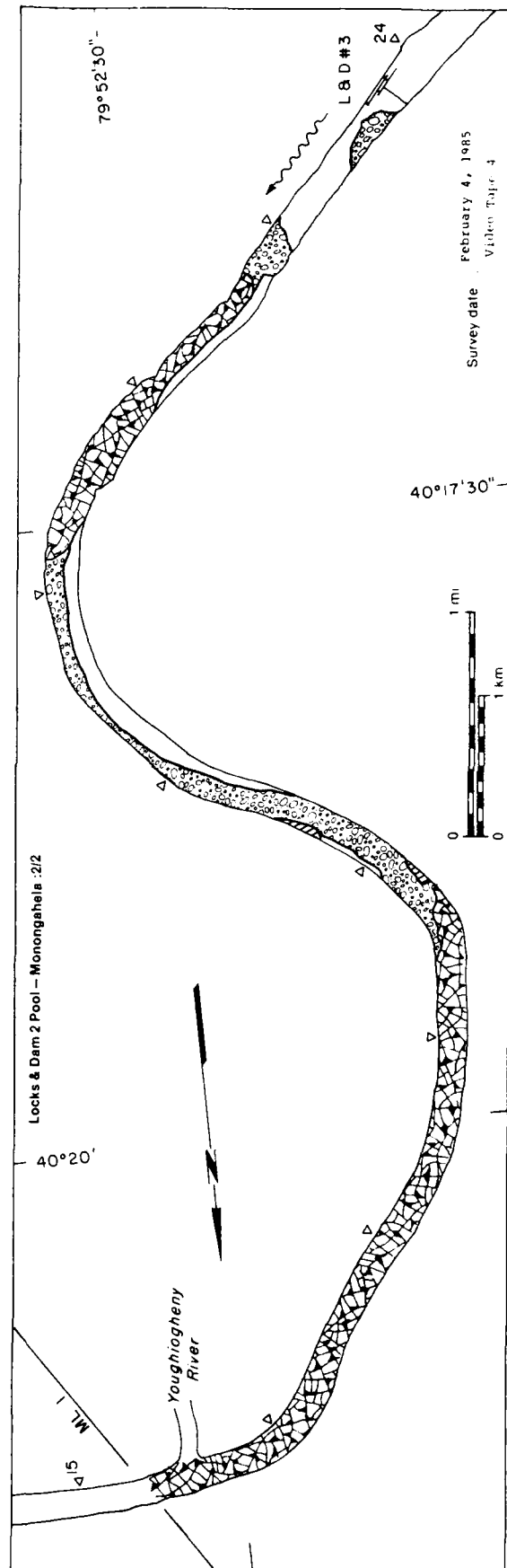
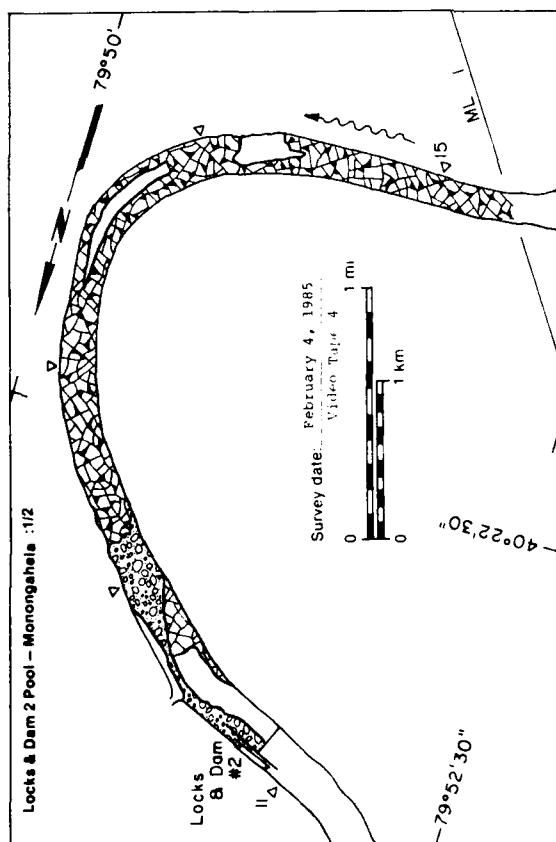
Area (sq. ft.)	Area (sq. ft.)
0.61	90
2.09	50
0.52	
1.51	
4.73	

Total Area (sq. ft.) = 4.73



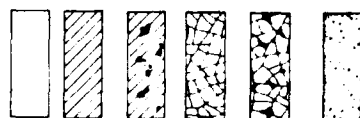


4 February 1985

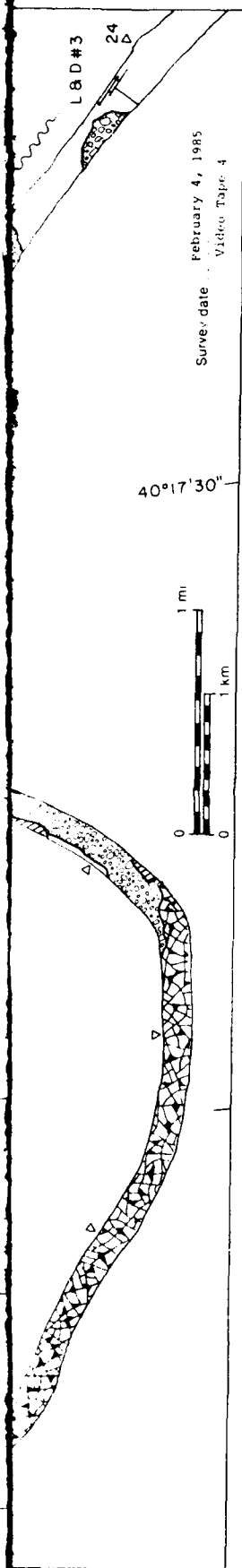


Locks & Dam 2 Pool - Monongahela

MAP UNITS



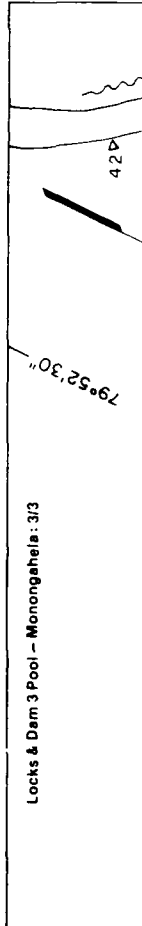
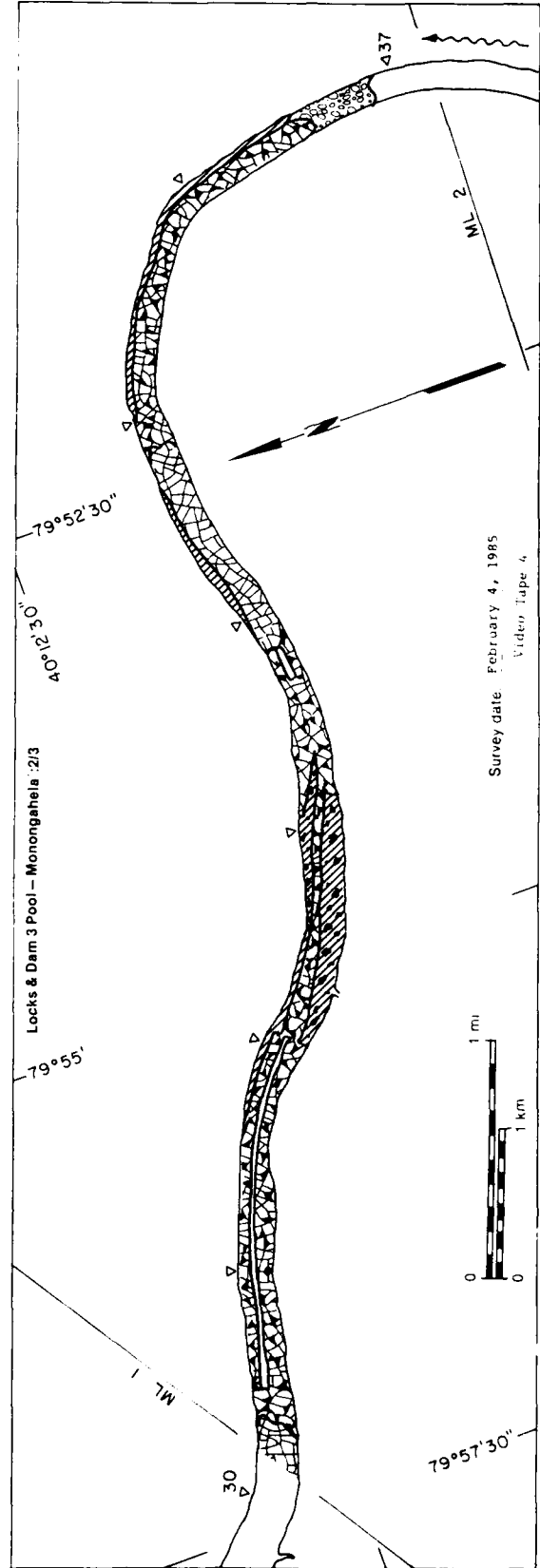
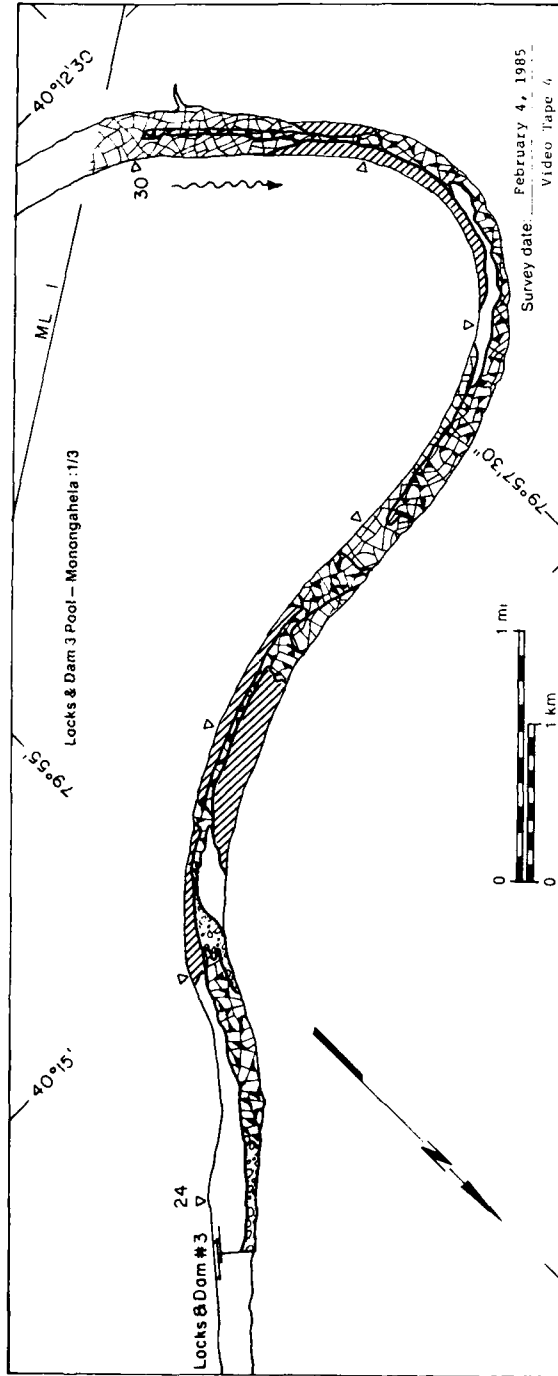
Area $\times 10^6$ ($m^2 \times 10^6$)	Surface concentration (%)
0.97	NA
0.03	NA
--	--
0.12	NA
2.64	70
1.01	20
Total Area ($m^2 \times 10^6$)	4.77



40°17'30"

Survey date February 4, 1985
Video Tape 4

4 February 1985

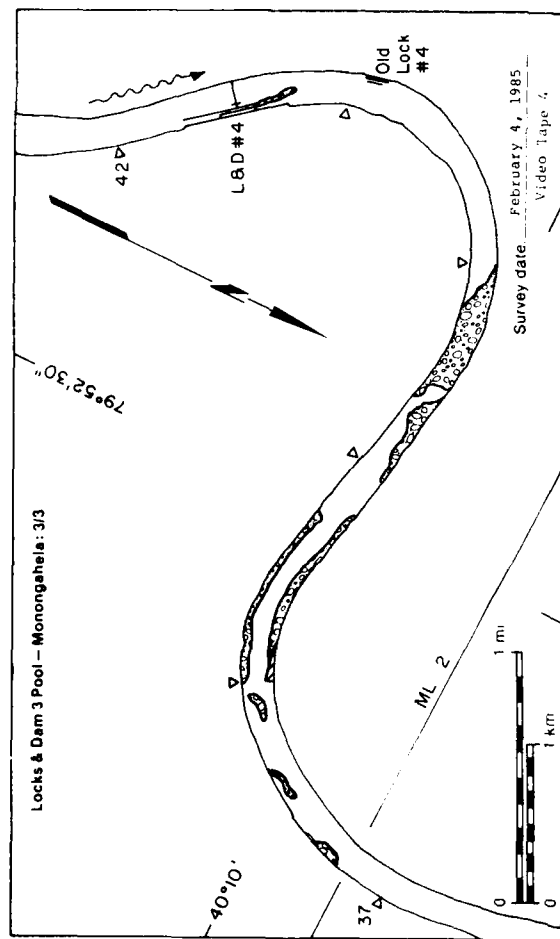
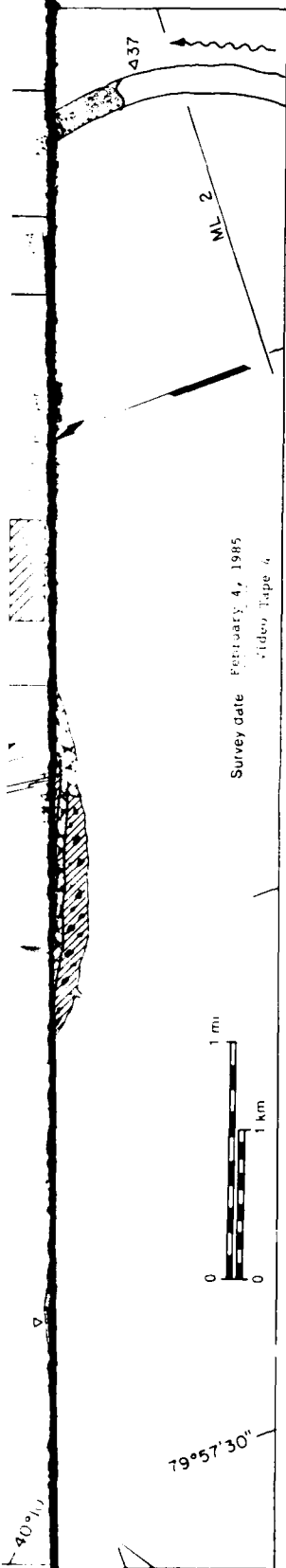


Locks & Dam 3 Pool - Monongahela

MAP UNITS

Surface concentration (N)

Area (m² x 10⁶)



Locks & Dam 3 Pool - Monongahela

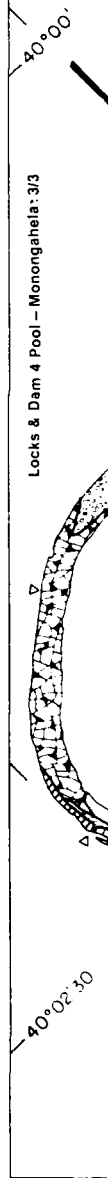
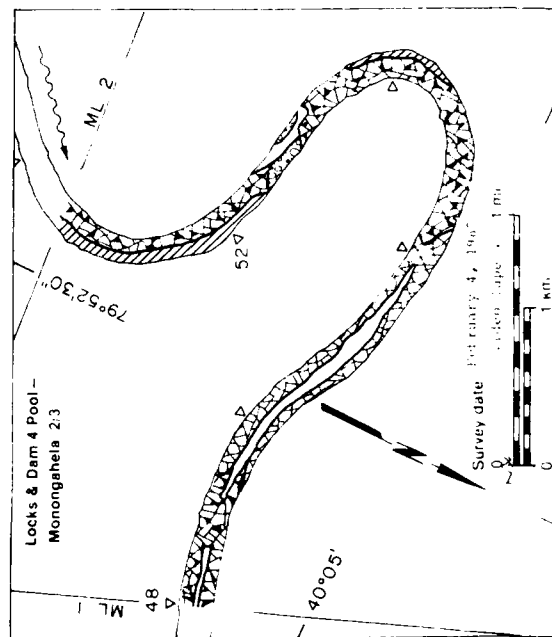
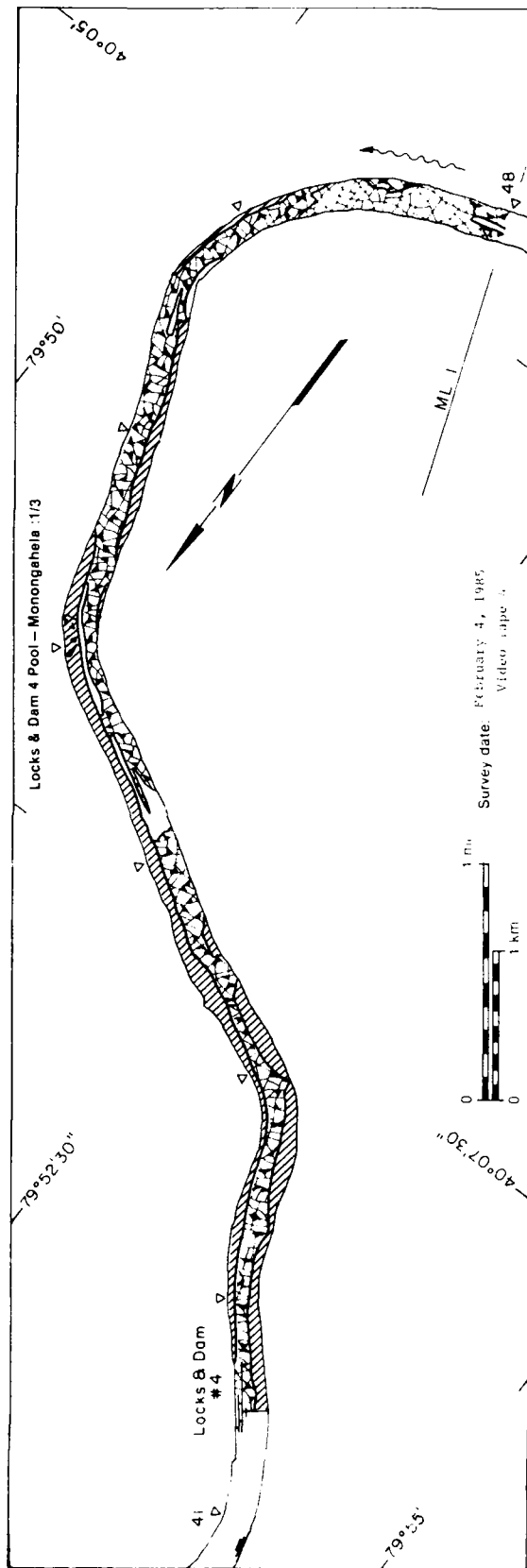
MAP UNITS

	Open water
	Solid ice cover
	Solid ice cover with open water areas
	Fragmented ice cover
	Fragmented ice cover with open water areas
	Ice floes or frazil slush and pans

Area ⁶ (m ² x 10 ⁶)	Surface concentration (%)
1.61	NA
0.94	NA
0.35	90
1.22	NA
1.93	75
0.59	10
6.64	

Total Area (m² x 10⁶)

4 February 1985



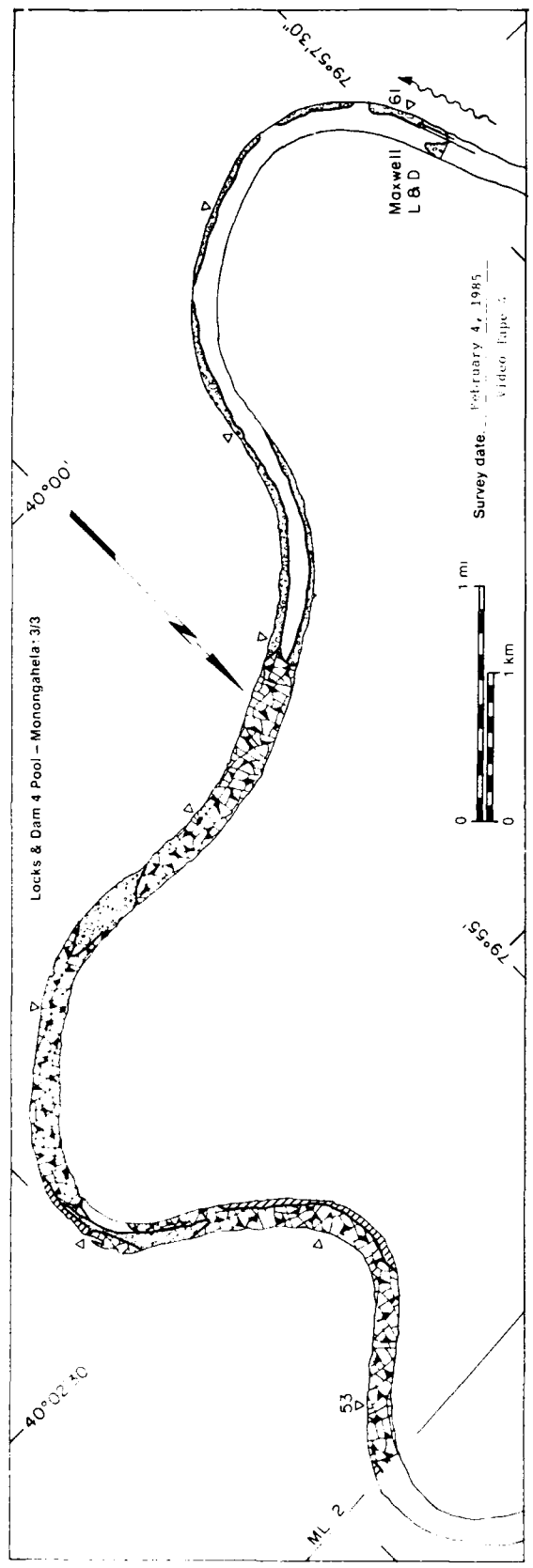
Locks & Dam 4 Pool - Monongahela

MAP UNITS	Area 6 (m ² x 10 ⁶)	Surface concentration (%)
Open water	1.09	NA
Solid ice cover	1.11	NA
Solid ice cover with open water areas	0.03	90
Fragmented ice cover	0.56	NA
Fragmented ice cover with open water areas	3.26	80
Low flows or frazil slush and pans	0.55	30
Total Area (m ² x 10 ⁶)	6.60	

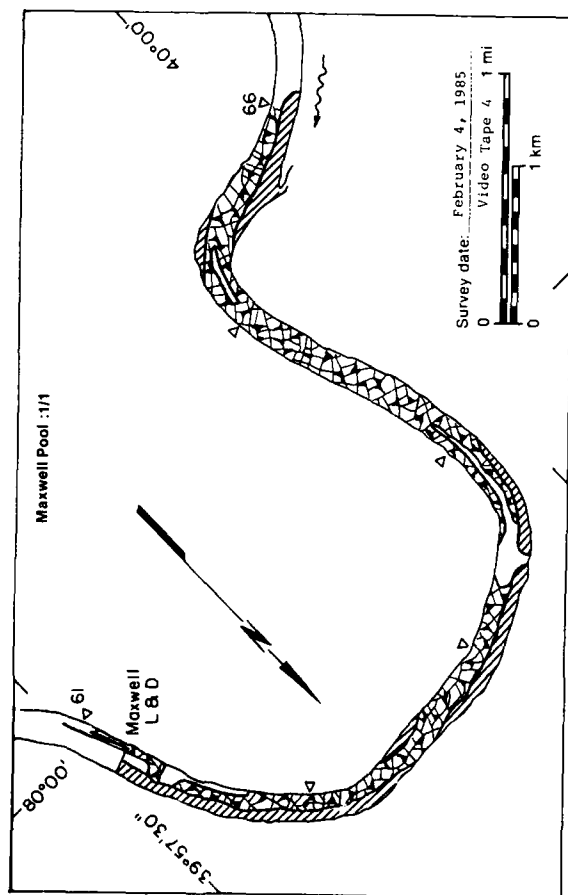


Total Area (mi² x 10⁶)

6.66



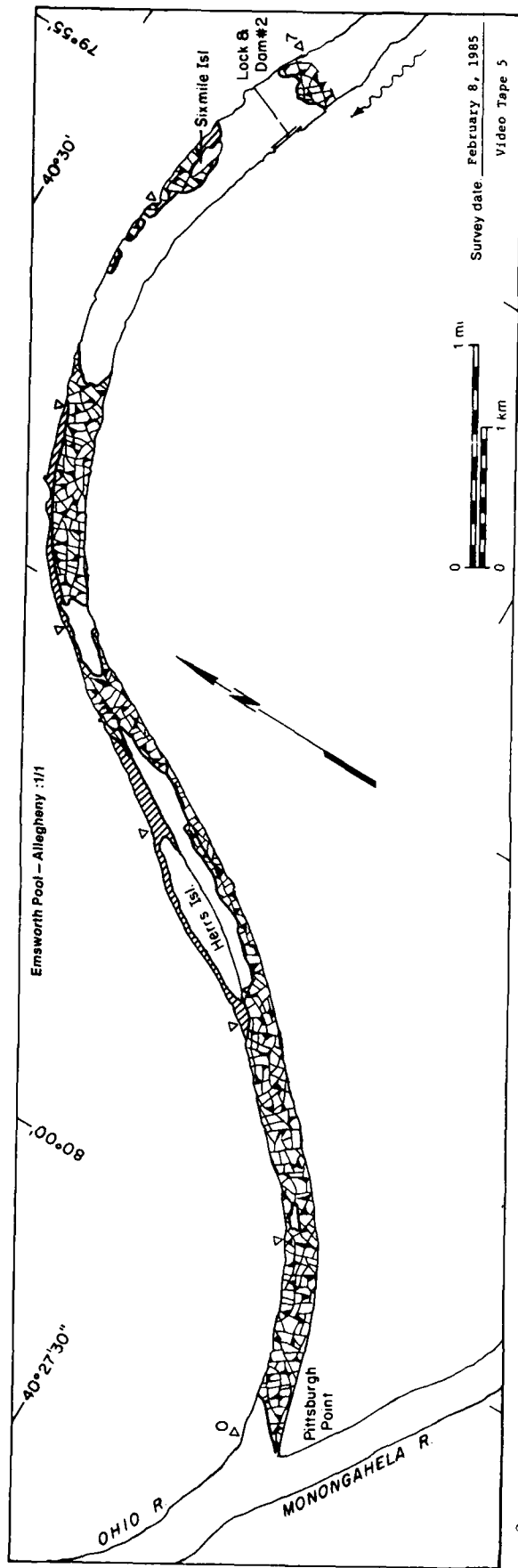
4 February 1985



Maxwell Pool

MAP UNITS	Area ϵ_i ($m^2 \times 10^6$)	Surface concentration (%)
Open water	0.17	NA
Solid ice cover	0.42	NA
Solid ice cover with open-water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	0.97	80
Ice floes or frazil slush and pans	--	--
Total Area ($m^2 \times 10^6$)	1.56	

8 February 1985

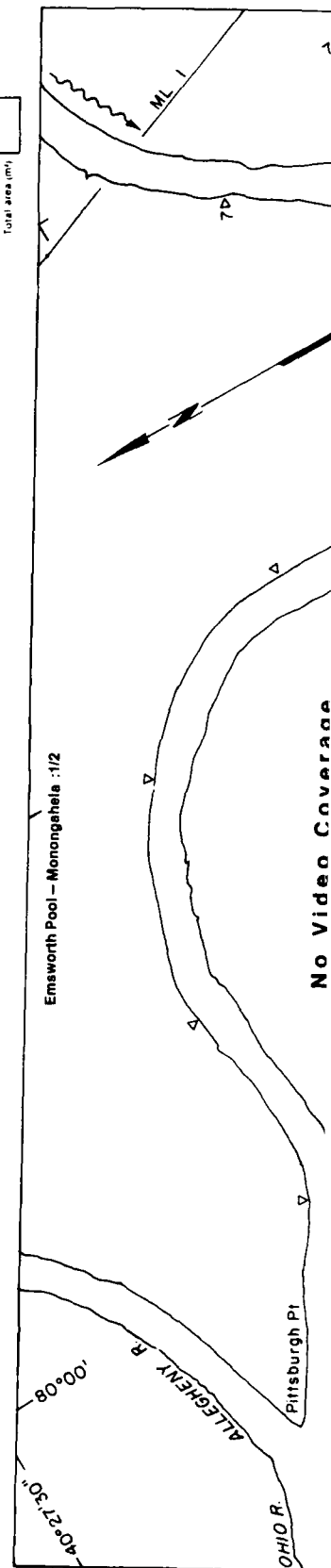


□ Emsworth Pool - Allegheny

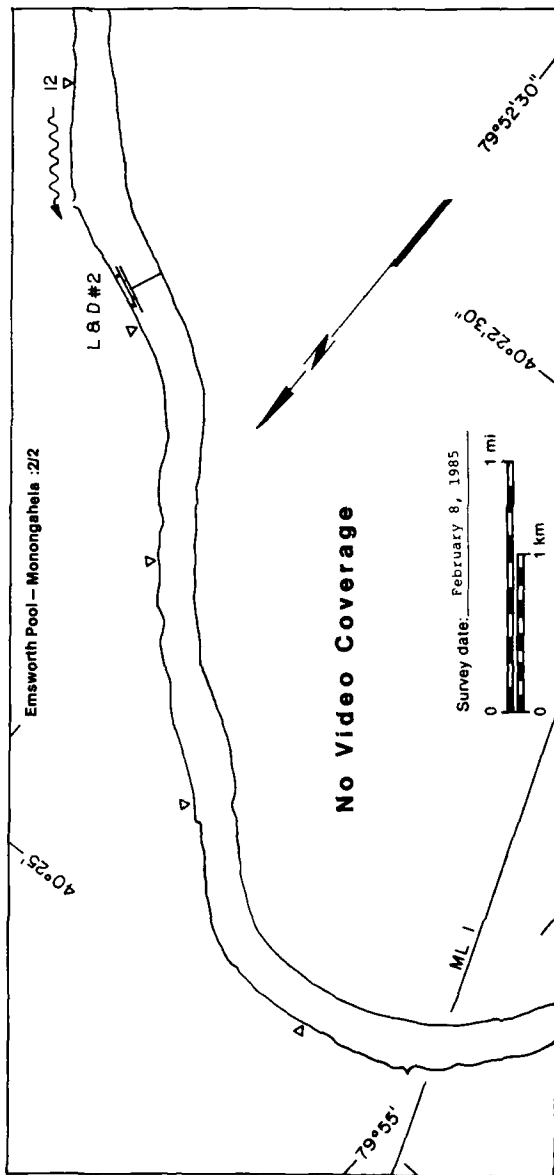
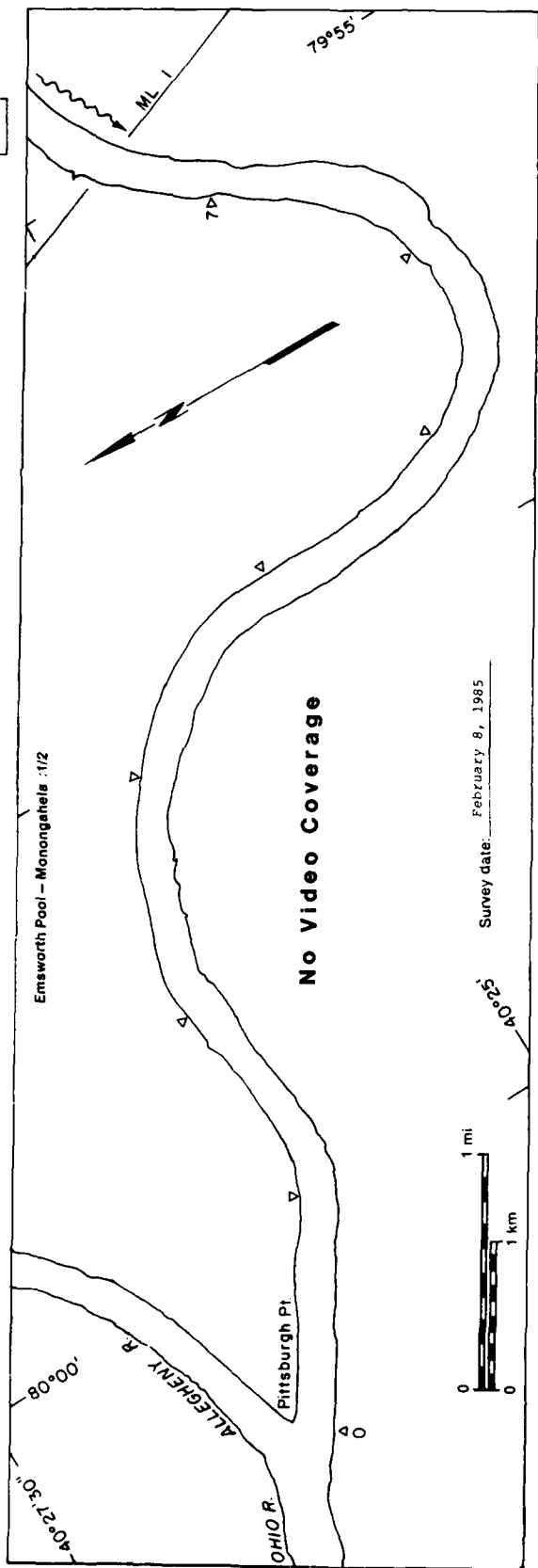
MAP UNIT	Area S_1 concentration ($10^6 \times 10^6$)	Surface concentration (%)
Open water	1.22	NA
Solid ice cover	0.28	NA
Solid ice cover with open water areas	—	—
Fragmented ice cover	0.05	NA
Fragmented ice cover with open water areas	1.72	80
Ice floes or frazil slush and pans	—	—
Total Area ($10^6 \times 10^6$)	3.27	

□ Emsworth Pool - Monongahela

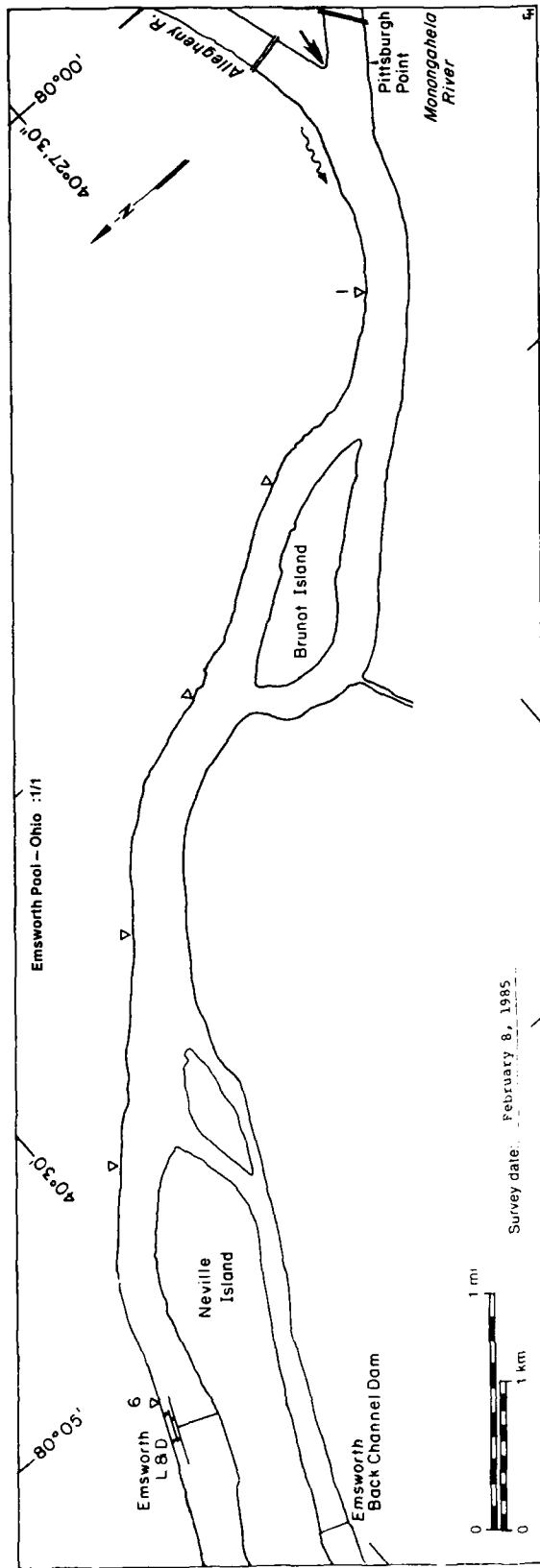
MAP UNIT	Area (mi ²)	Surface concentration (%)
Open water		NA
Solid ice cover		NA
Solid ice cover with open water areas		NA
Fragmented ice cover		NA
Fragmented ice cover with open water areas		
Ice floes or frazil slush and pans		
Total area (mi ²)		



No Video Coverage



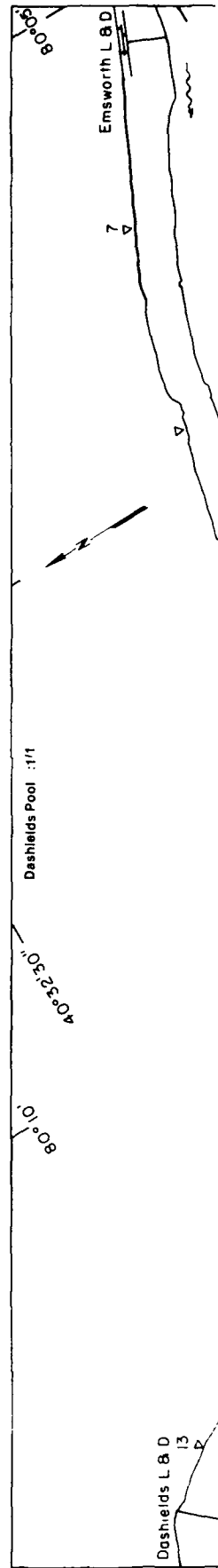
8 February 1985

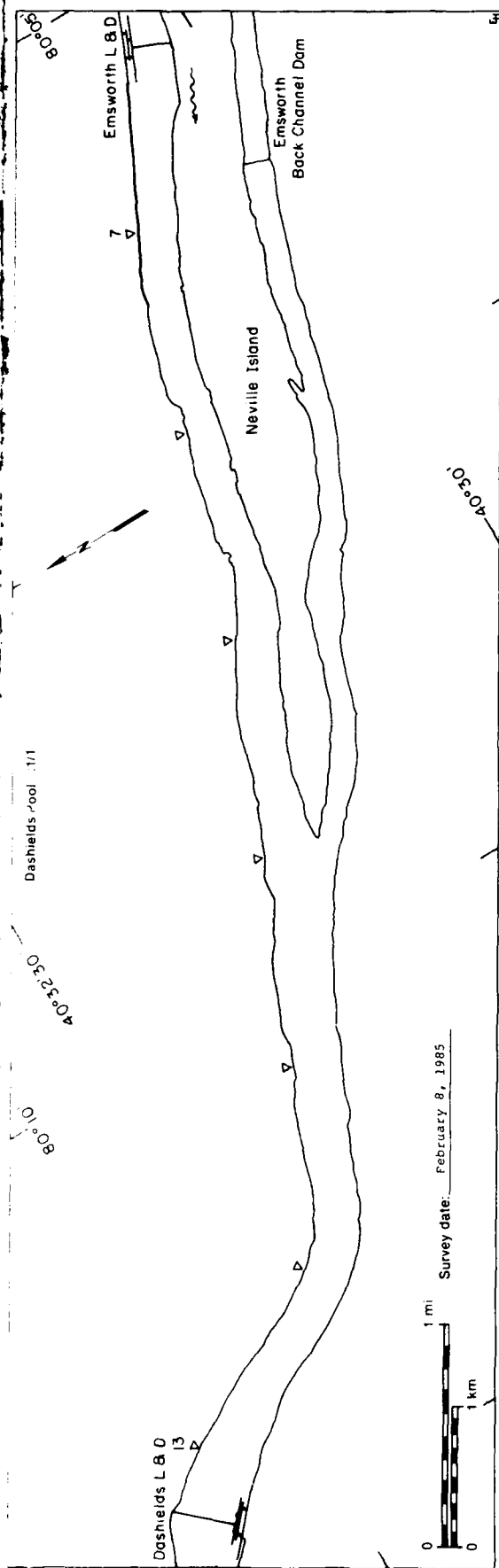


Emsworth Pool - Ohio

MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	--	NA
Solid ice cover	--	NA
Solid ice cover with open-water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	--	--
Ice floes or frazil slush and pans	--	--
Total Area (m ² x 10 ⁶)	4.49	

No Video Coverage

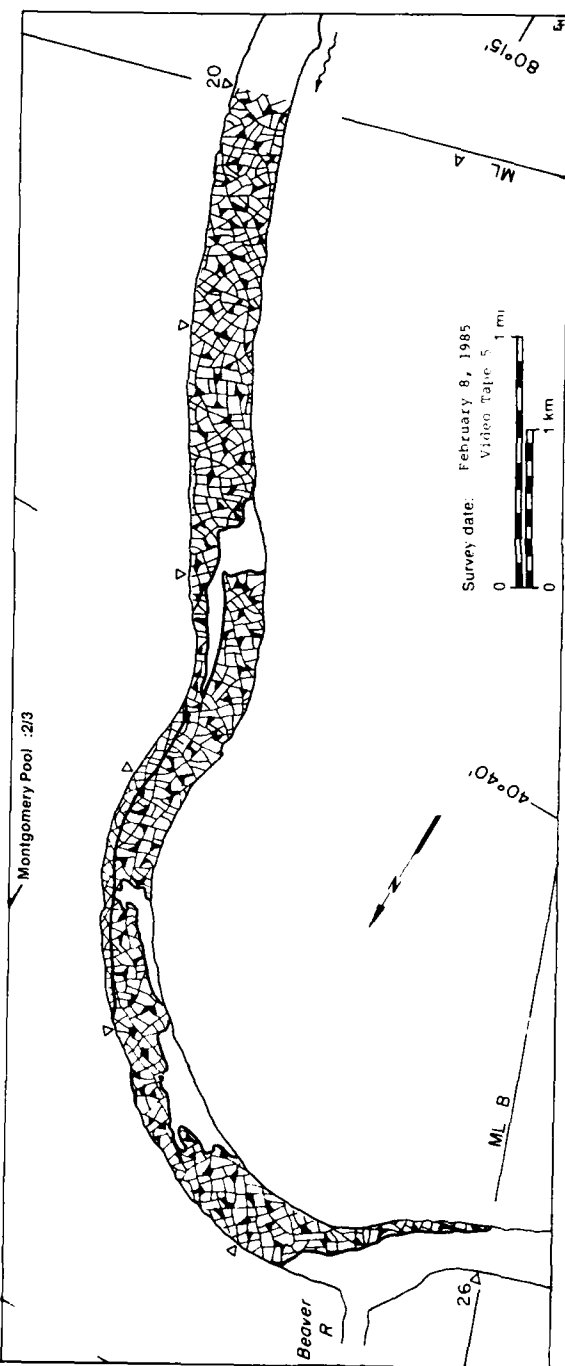
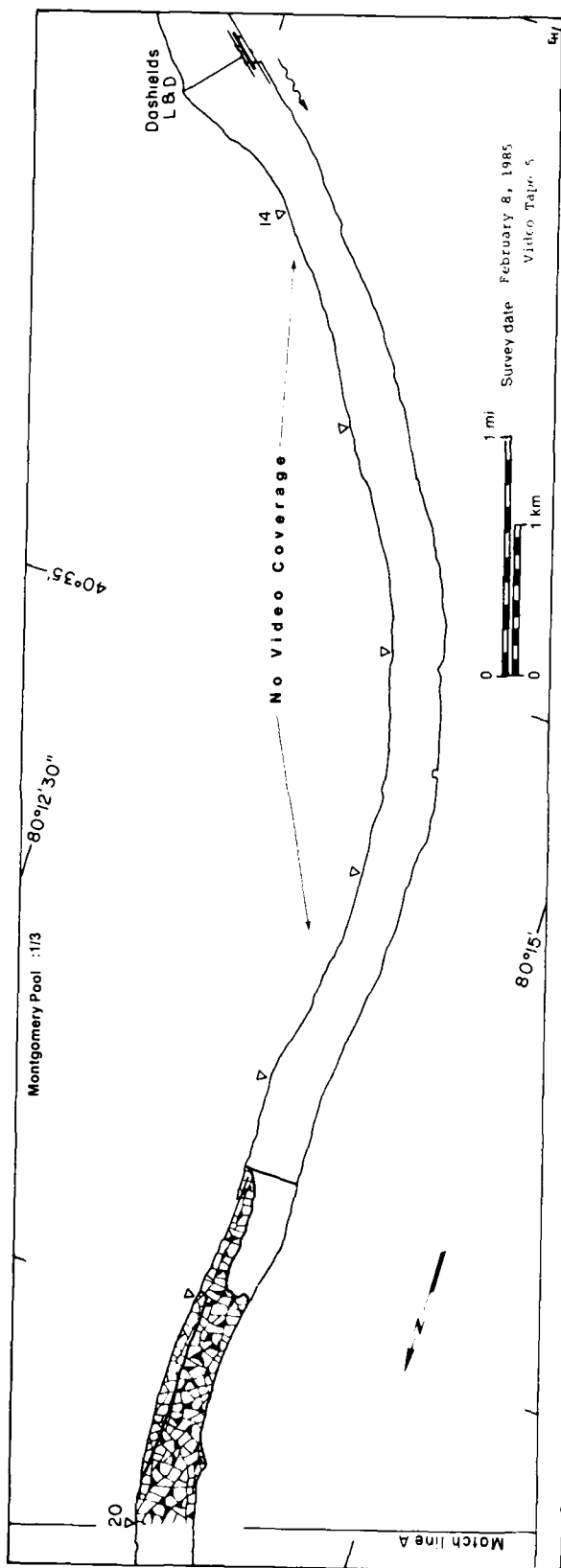


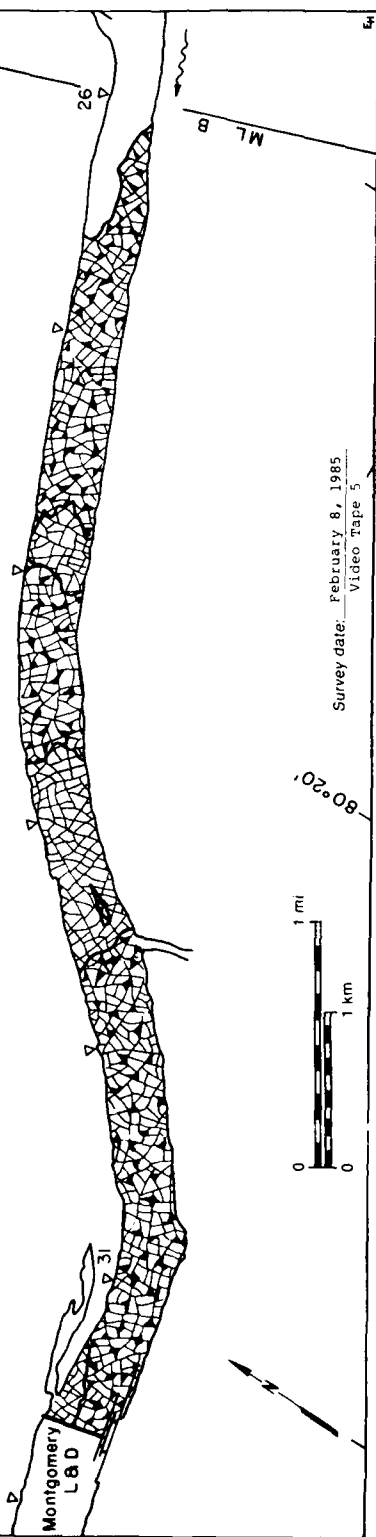


No Video Coverage

Dashields Pool		Area (m ² x 10 ⁶)	Surface concentration (%)
MAP UNITS			
Open water	NA	---	NA
Solid ice cover	NA	---	NA
Solid ice cover with open water areas	---	---	---
Fragmented ice cover	NA	---	NA
Fragmented ice cover with open water areas	---	---	---
Ice floes or frazil slush and pans	---	---	---
Total Area (m ² x 10 ⁶)		5.00	

8 February 1985



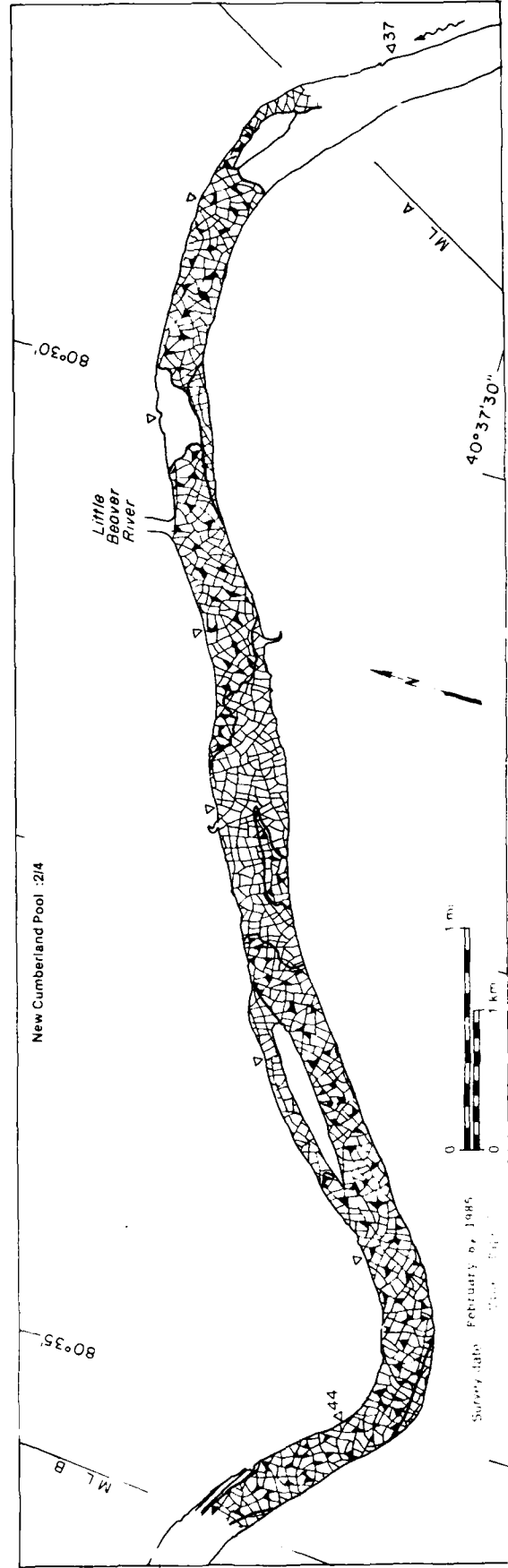
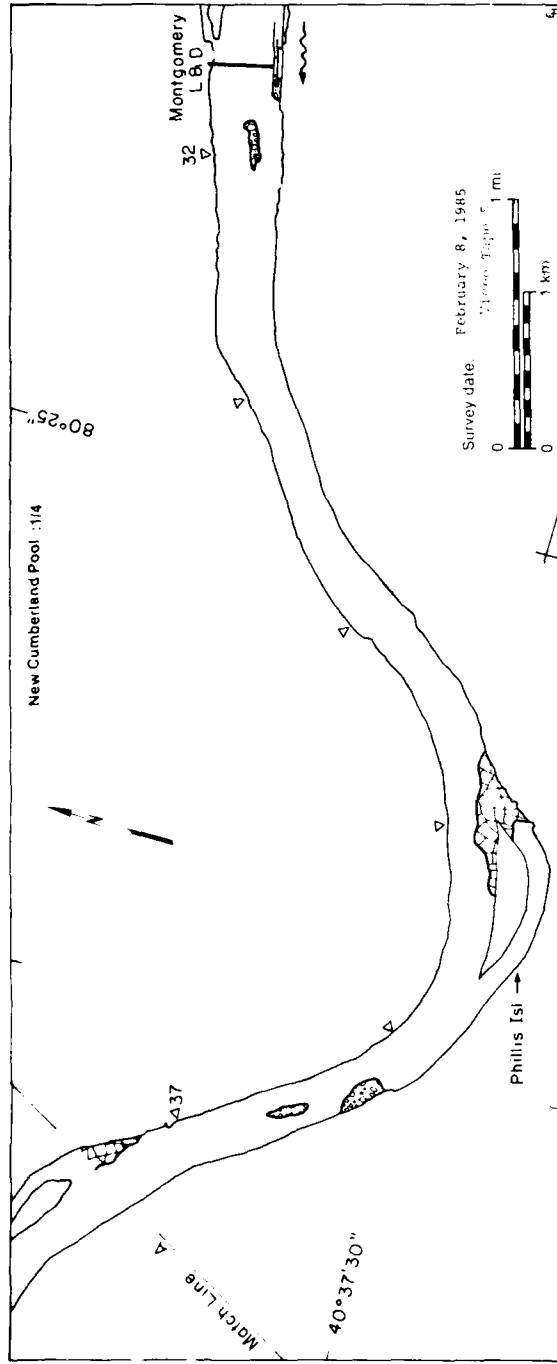


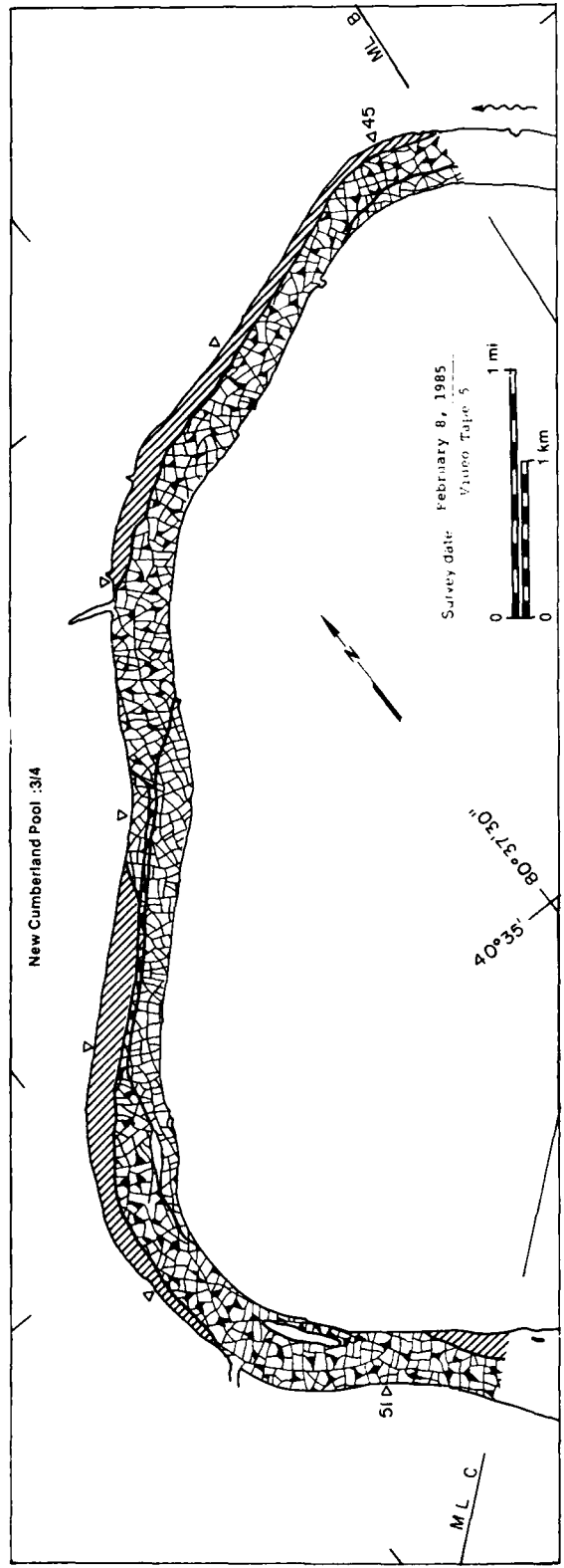
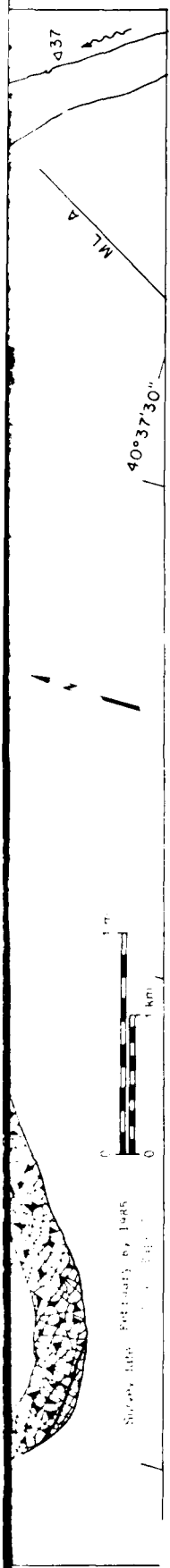
Montgomery Pool

MAP UNITS	Area ($m^2 \times 10^6$)	Surface concentration (%)
	1.28	NA
	--	NA
	--	--
	1.14	NA
	5.93	90
	--	--
Total Area ($m^2 \times 10^6$)	11.27*	

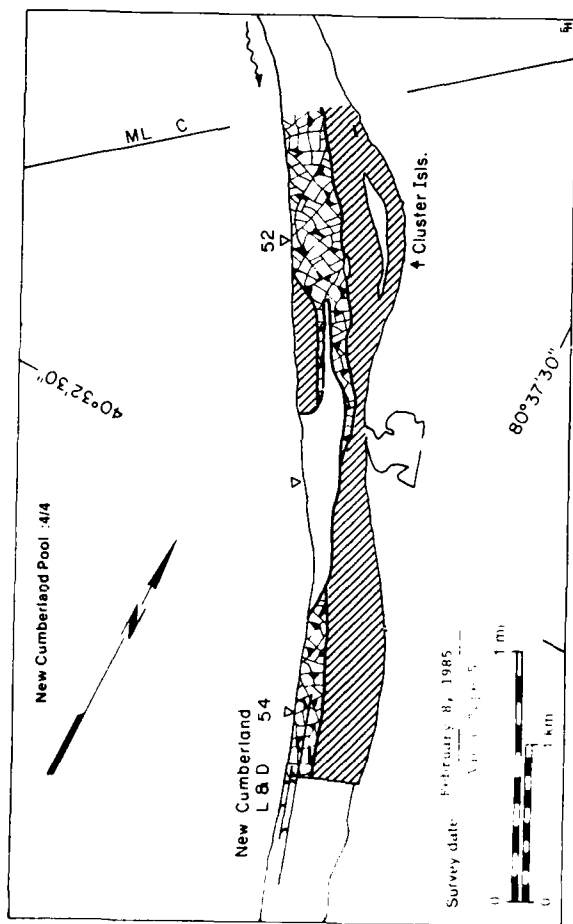
*Includes 2.92 of no video coverage

8 February 1985



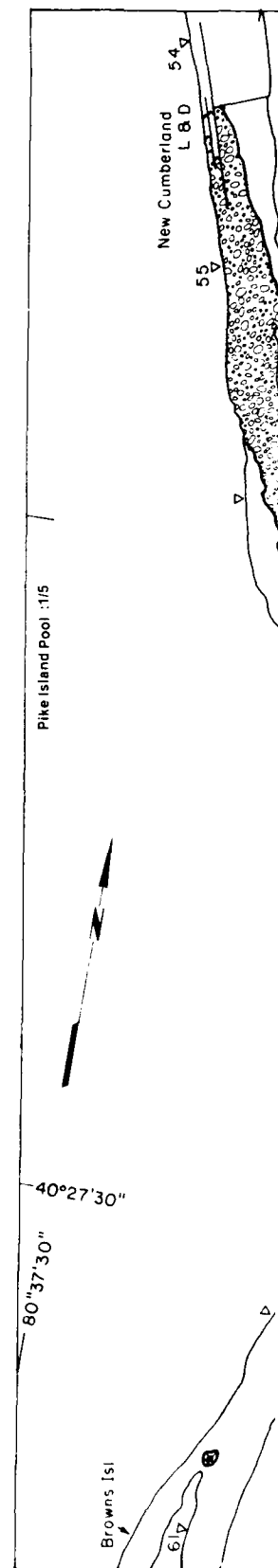


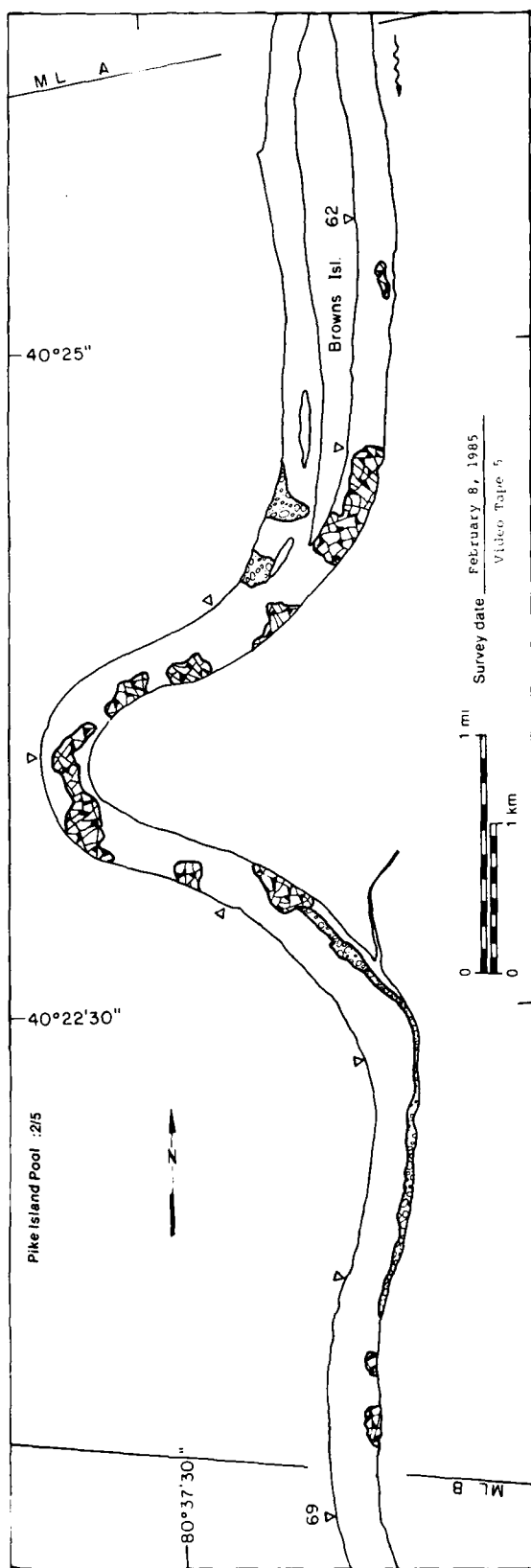
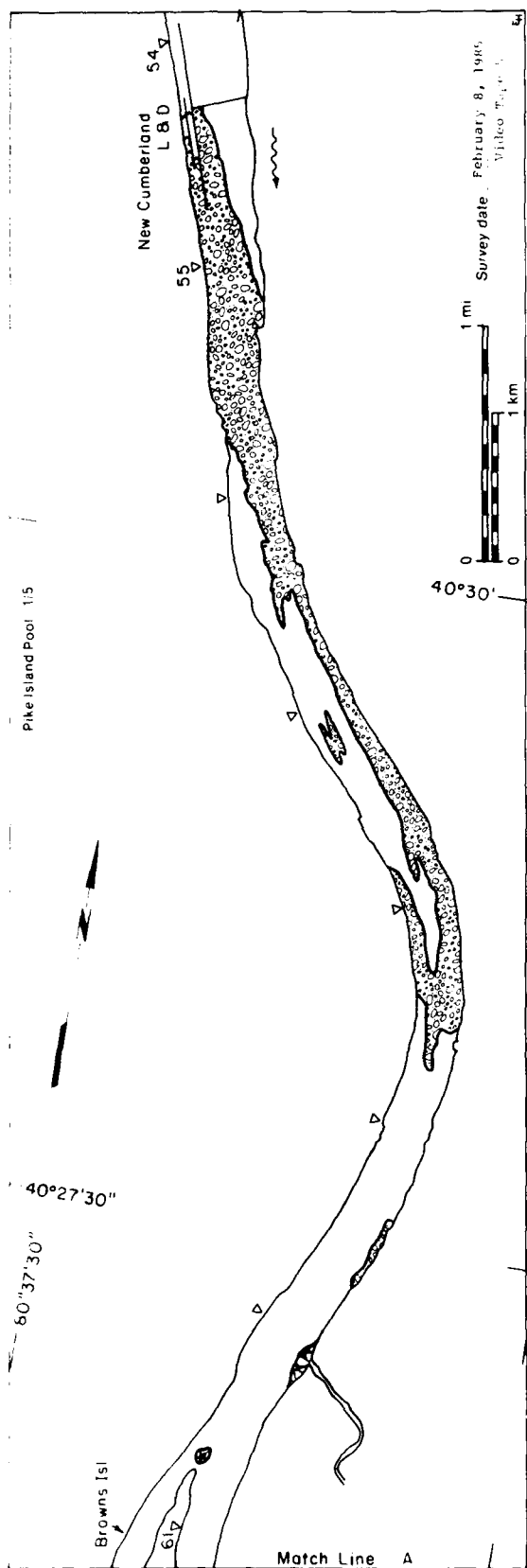
8 February 1985



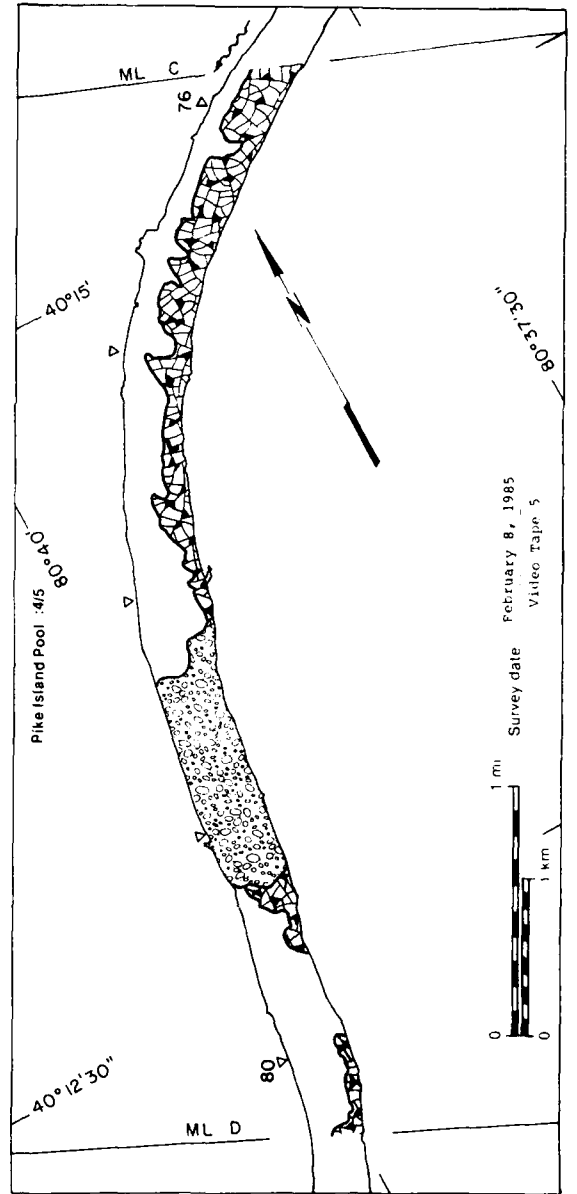
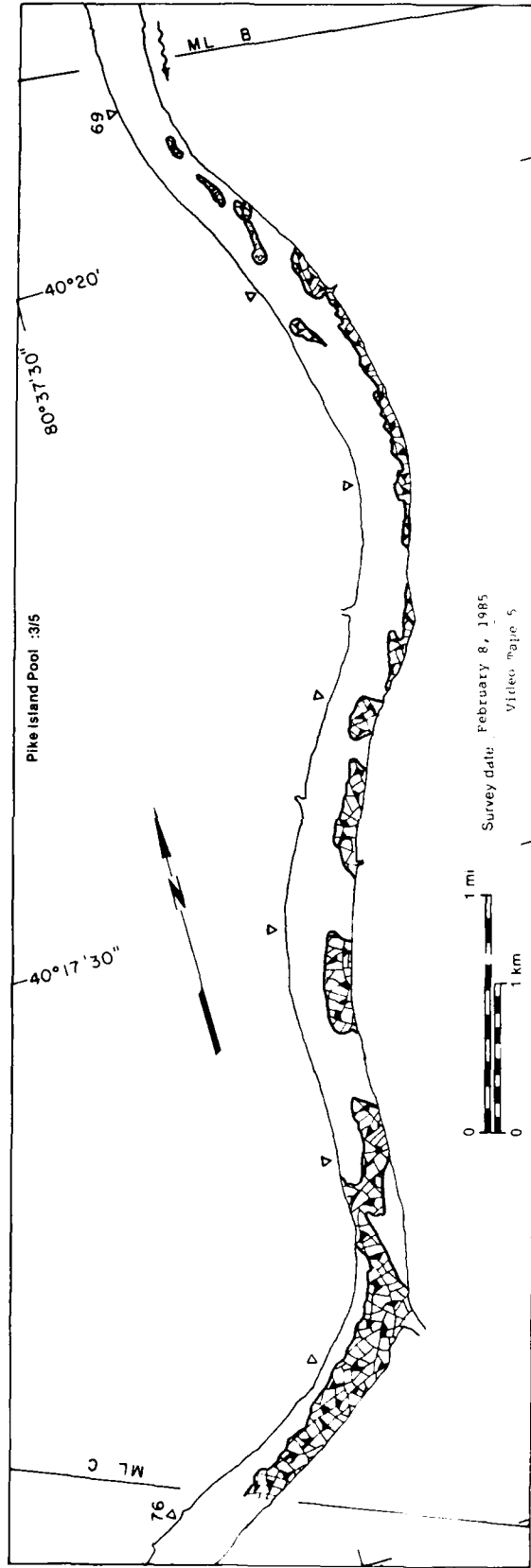
New Cumberland Pool

MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	3.76	NA
Solid ice cover	2.37	NA
Solid ice cover with open-water areas	--	--
Fragmented ice cover	2.10	NA
Fragmented ice cover with open-water areas	6.59	80
Ice floes or frazil slush and pans	0.05	30
Total Area (m ² x 10 ⁶)	14.87	





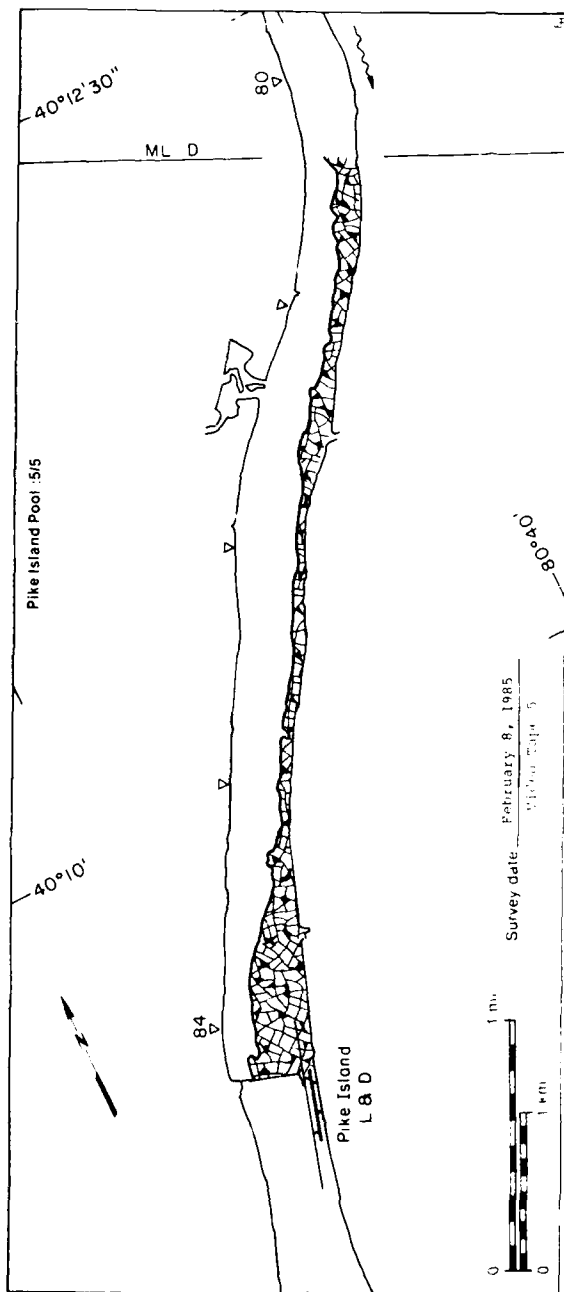
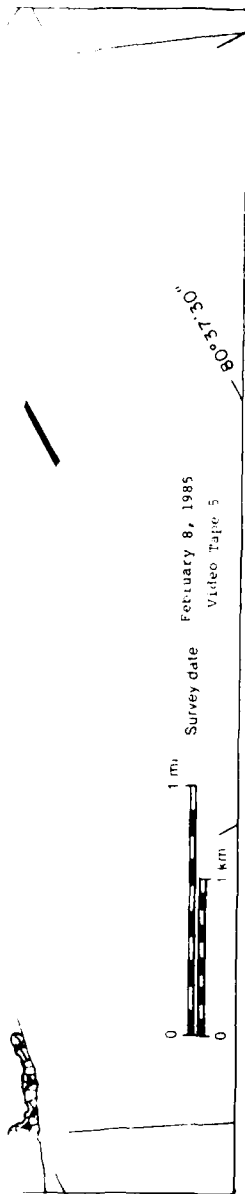
8 February 1985



Pike Island Pool :5/5

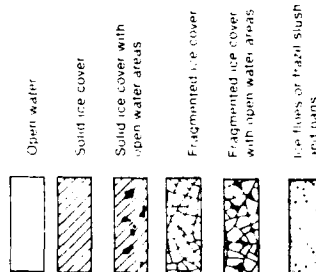
40°10'

40°12'30"



Pike Island Pool

MAP UNITS

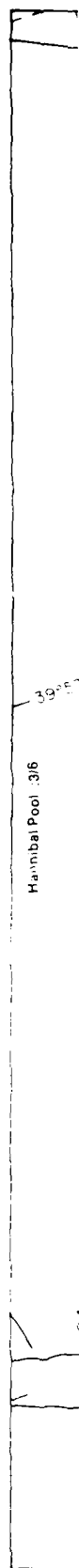
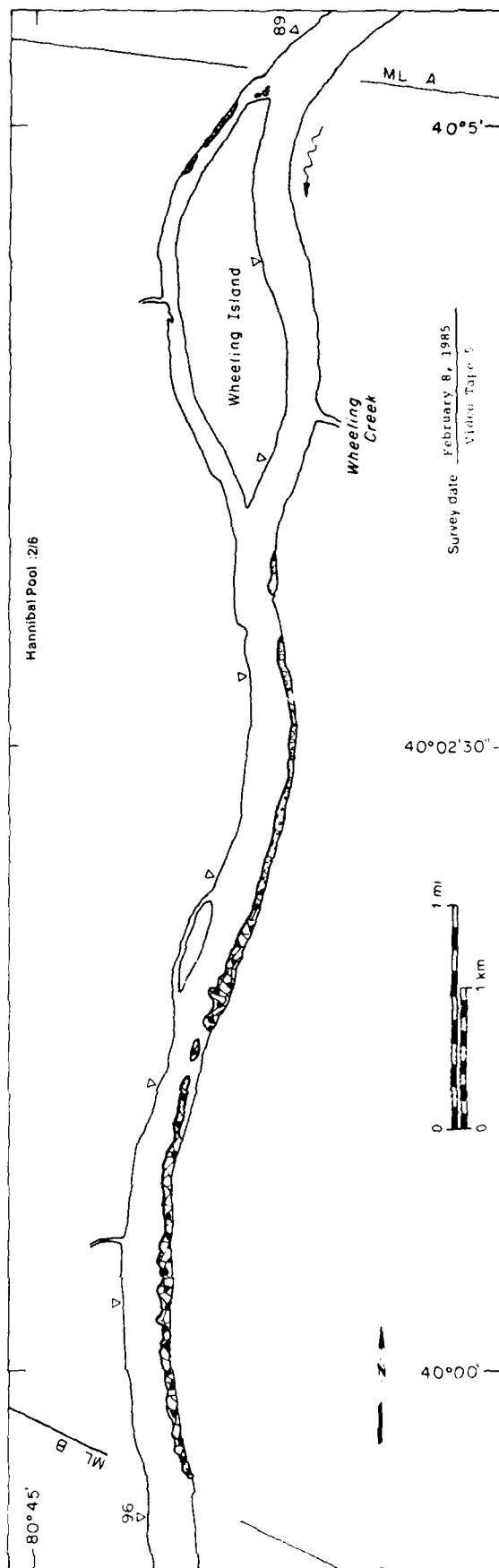
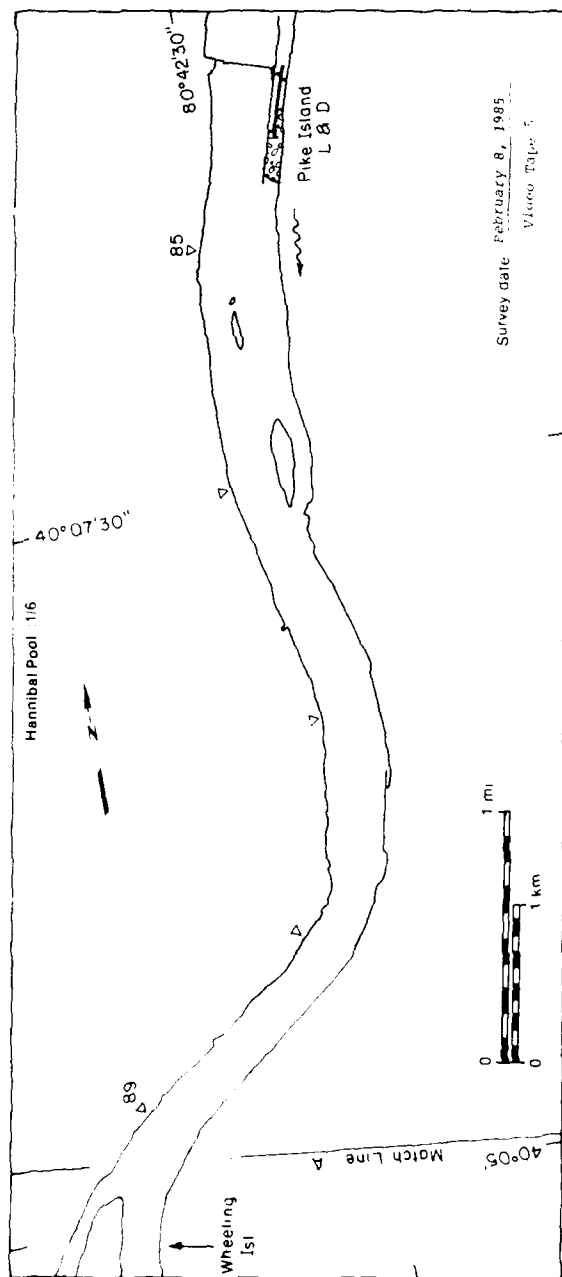


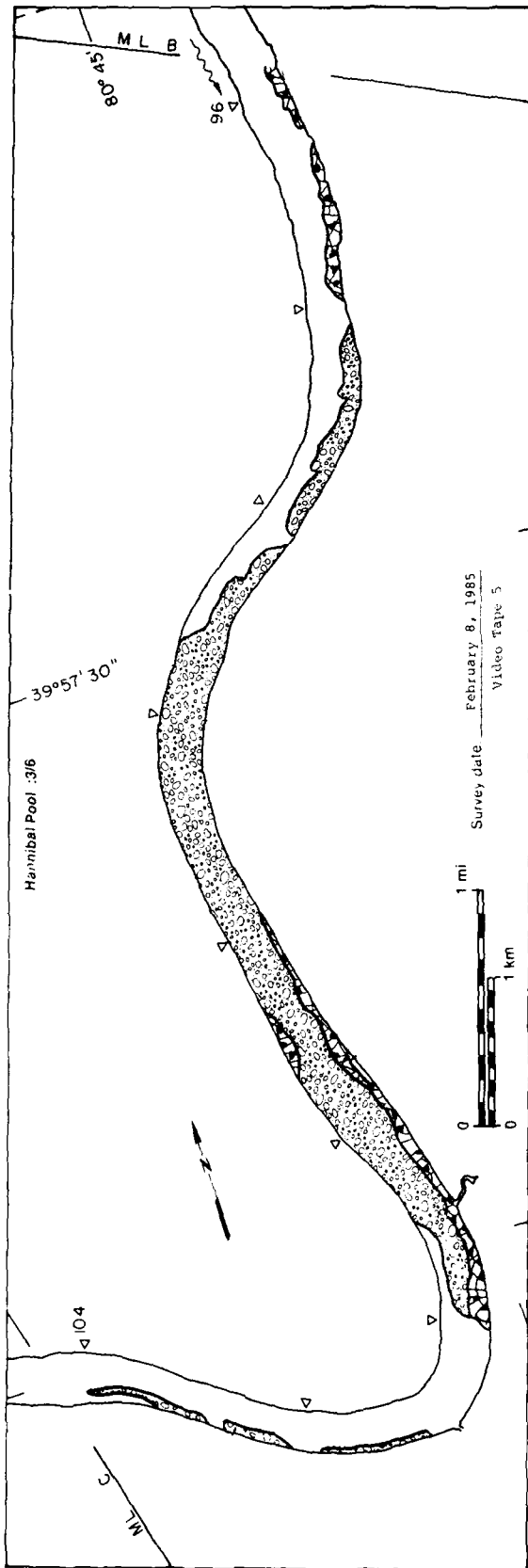
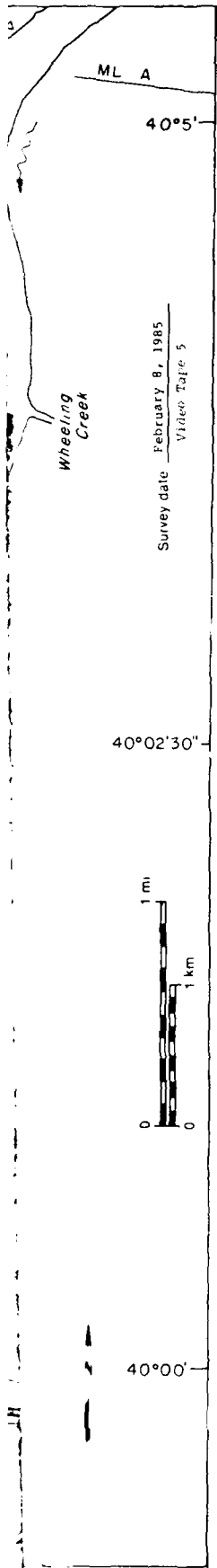
Area, $\text{m}^2 \times 10^6$

Area, $\text{m}^2 \times 10^6$	Surface concentration (%)
12.82	NA
--	NA
--	--
--	NA
3.61	90
2.49	40
18.92	

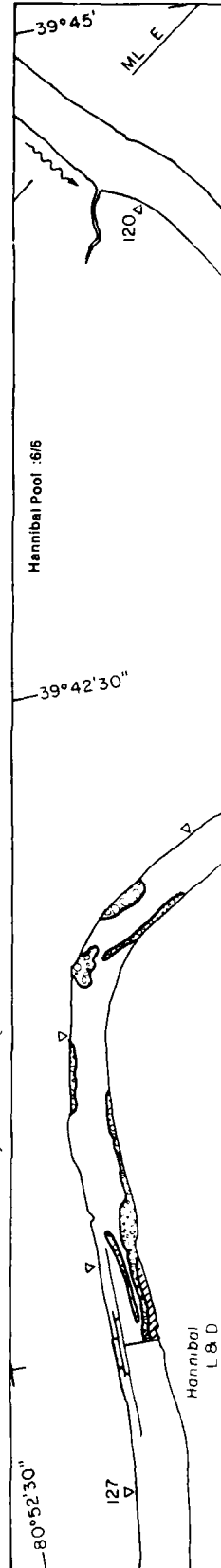
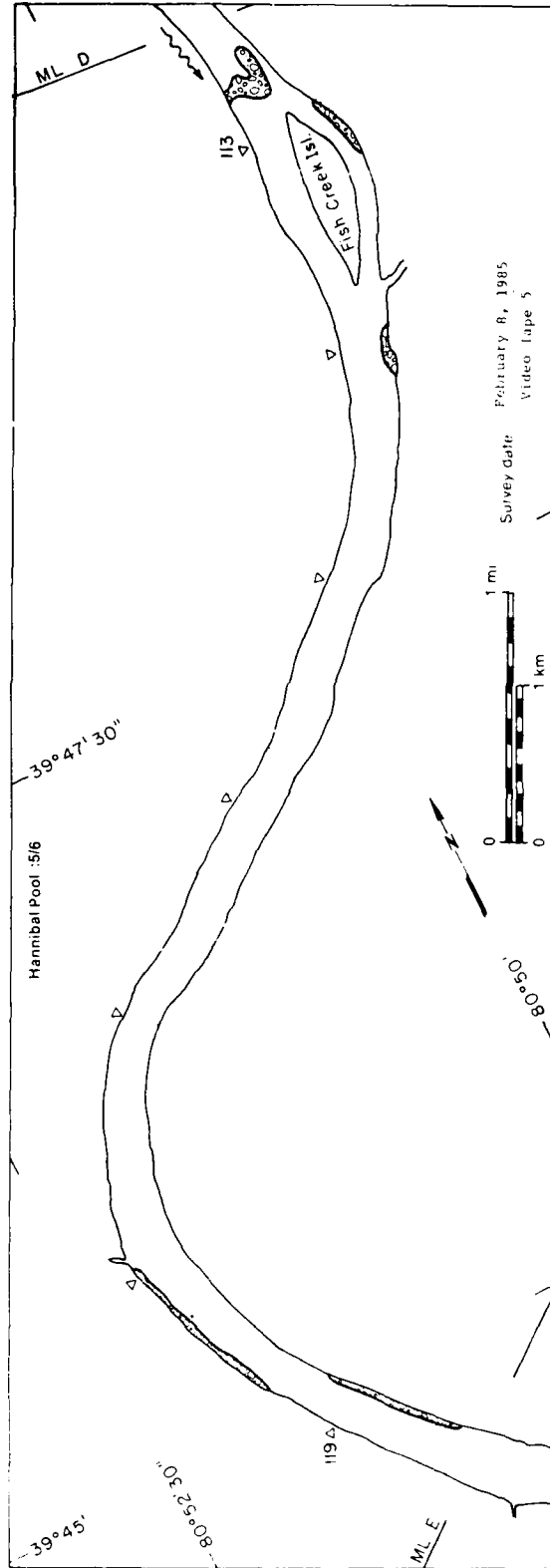
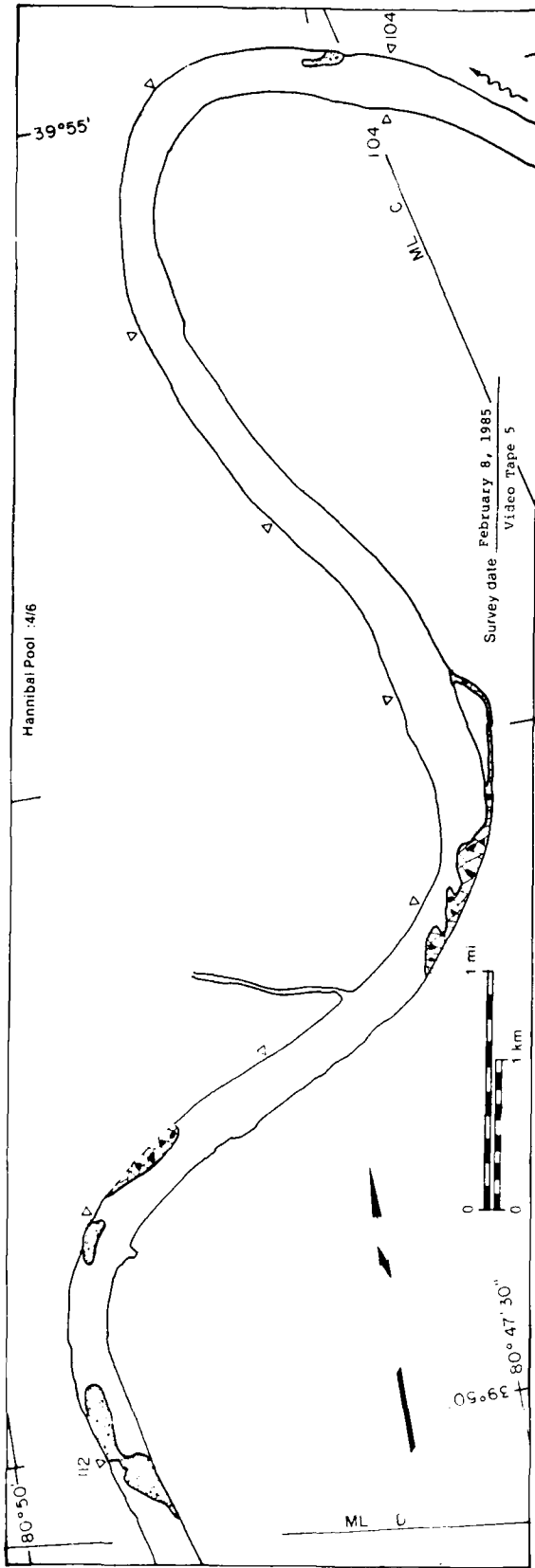
Total Area ($\text{m}^2 \times 10^6$)

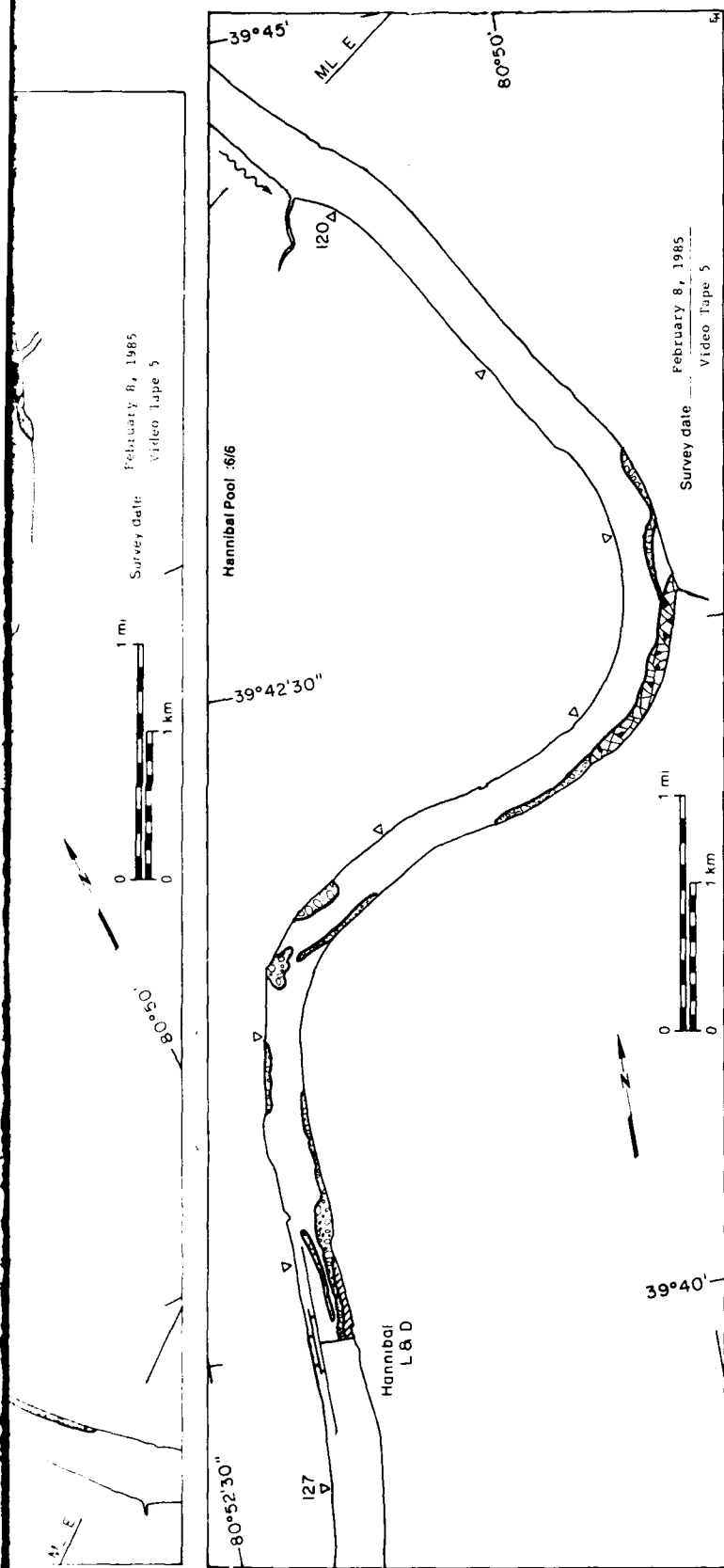
8 February 1985





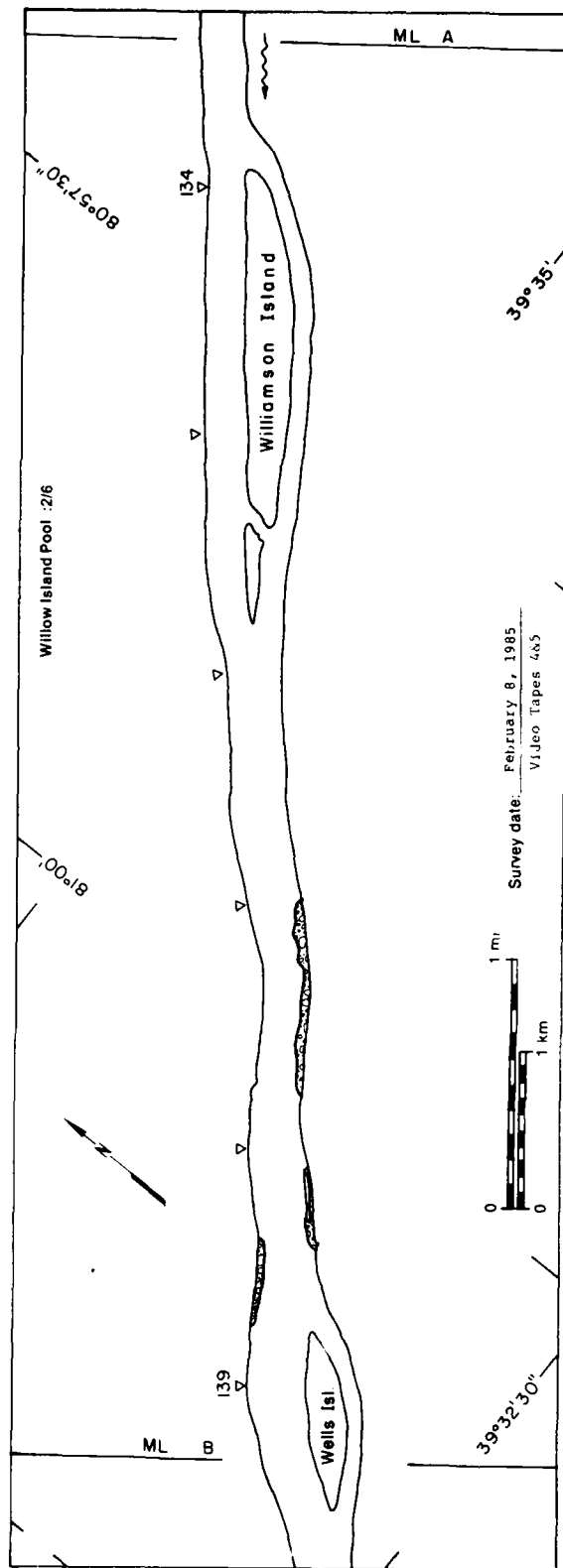
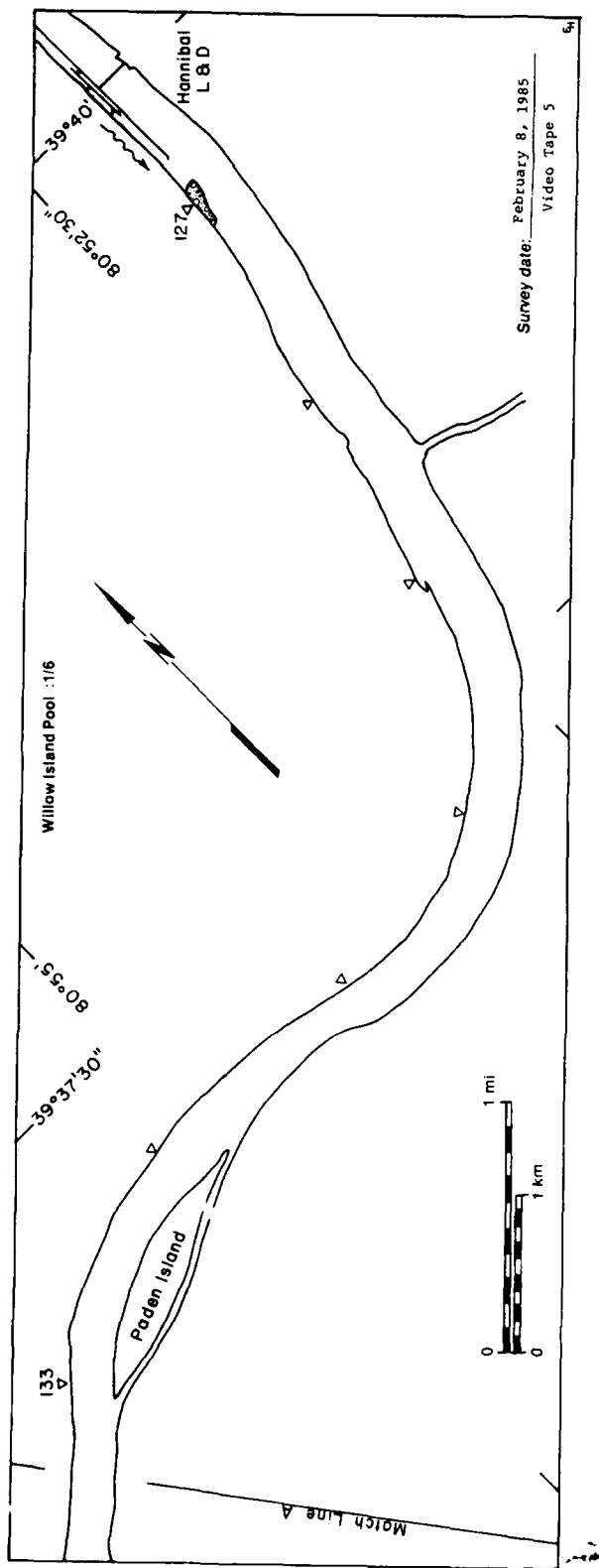
8 February 1985

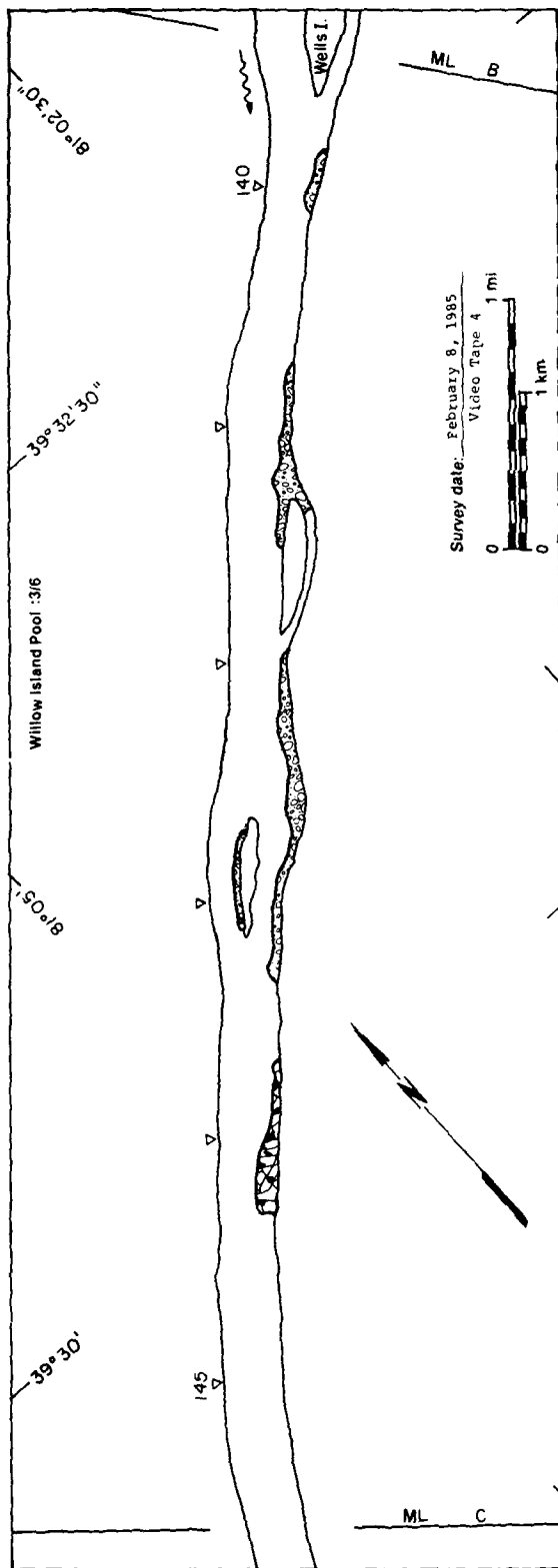
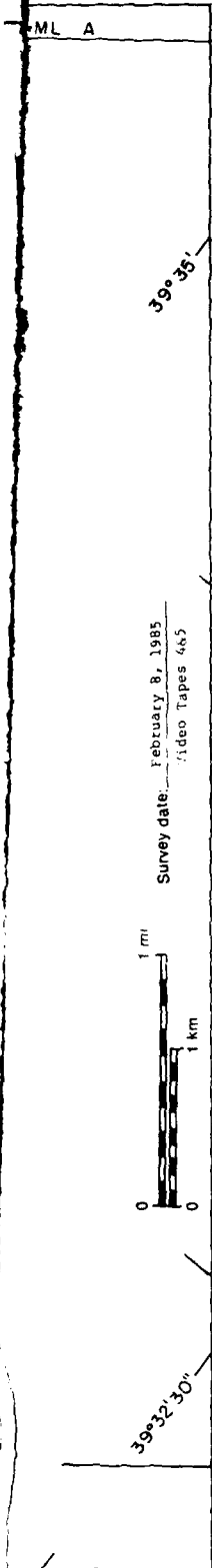




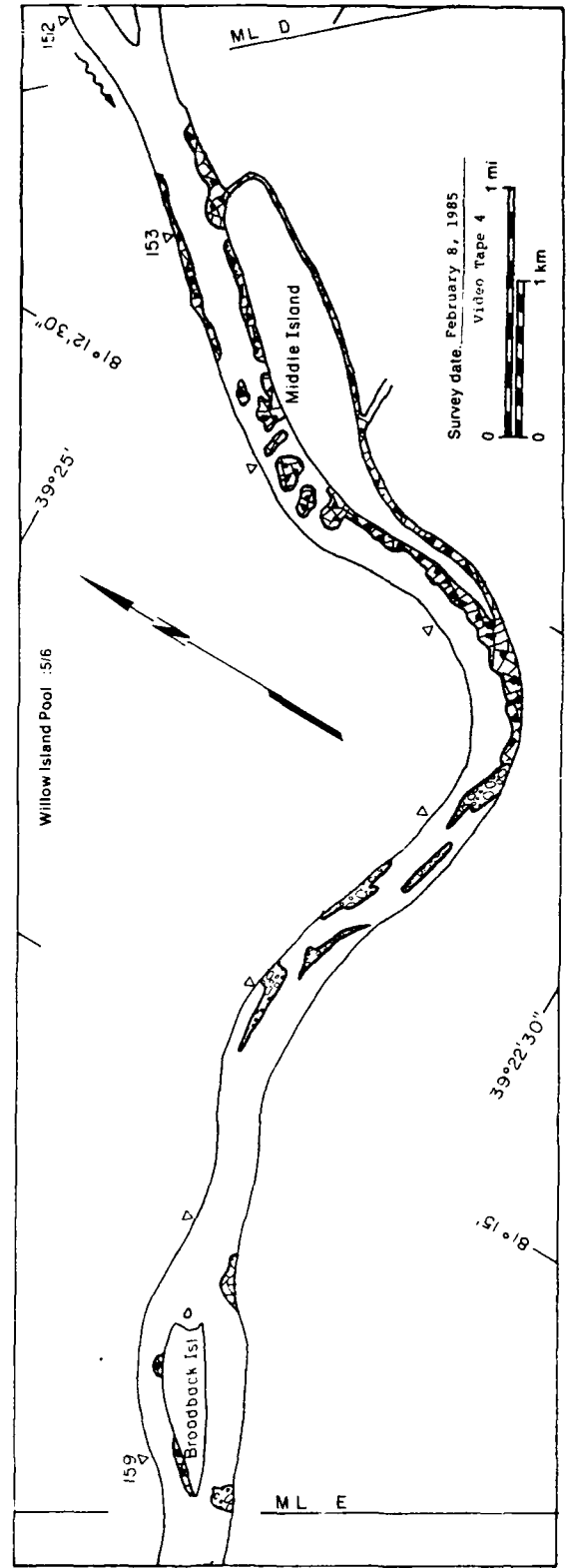
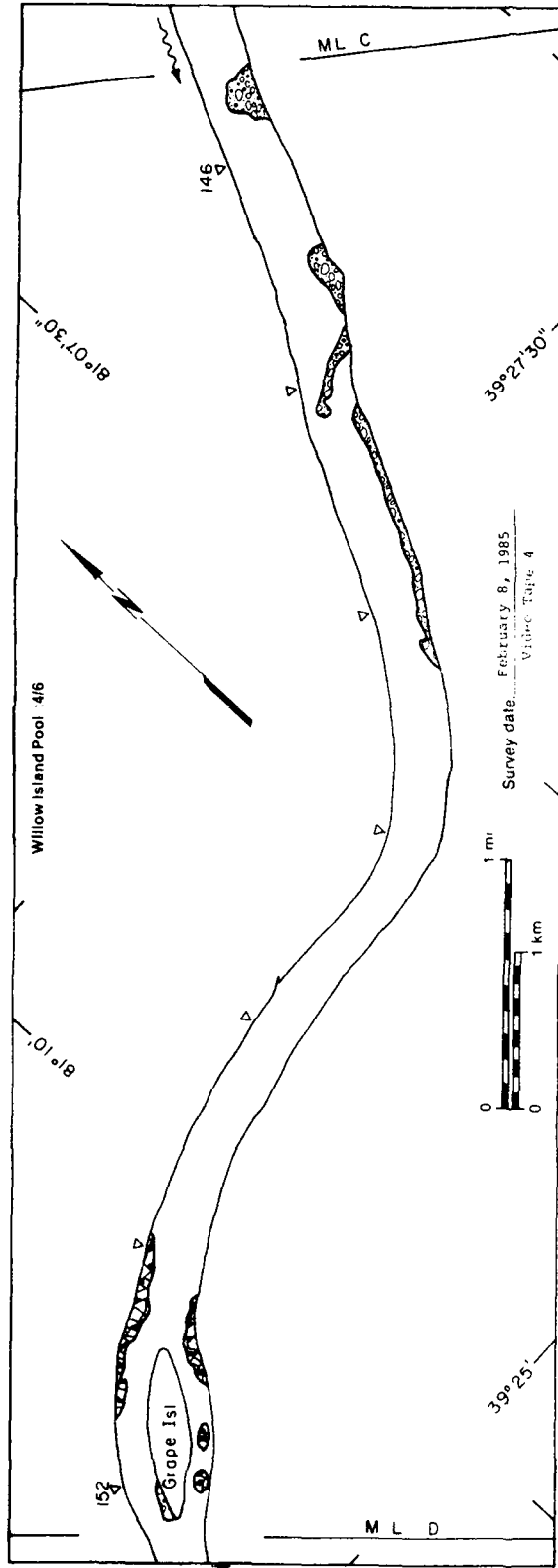
Hannibal Pool		Surface Area, ϕ concentration
MAP UNITS	($m^2 \times 10^6$)	(%)
Open water	18.77	NA
Solid ice cover	0.03	NA
Solid ice cover with open water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open water areas	1.01	90
Ice flows or frazil slush and pans	2.65	30
Total Area ($m^2 \times 10^6$)		22.46

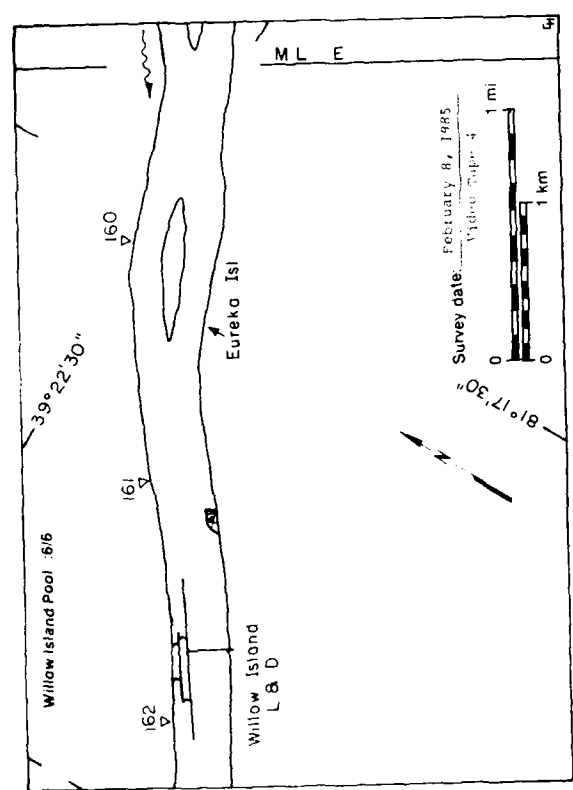
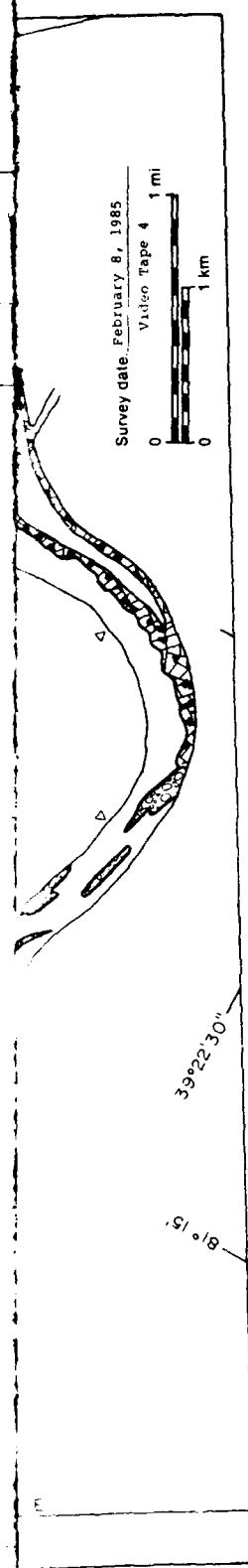
8 February 1985





8 February 1985

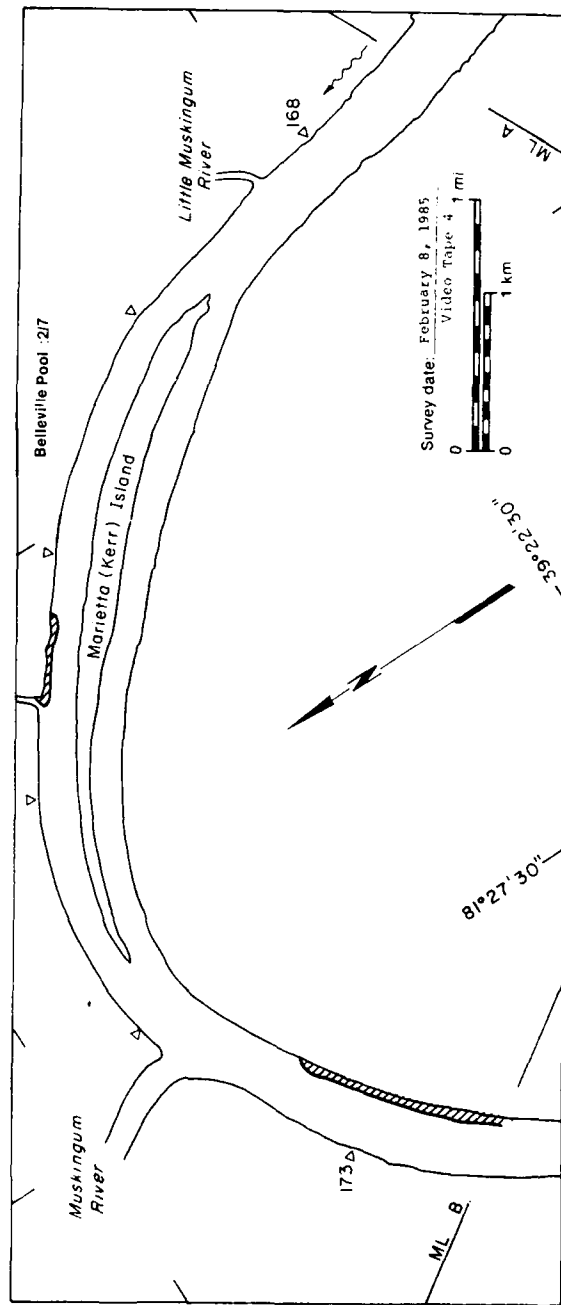
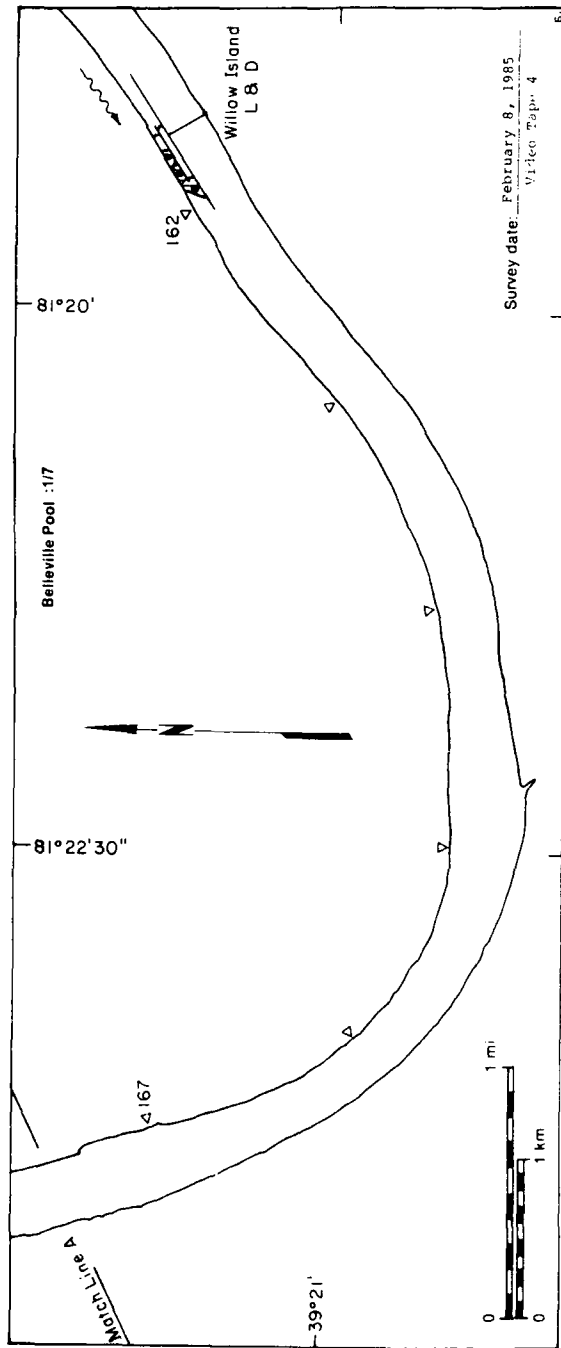


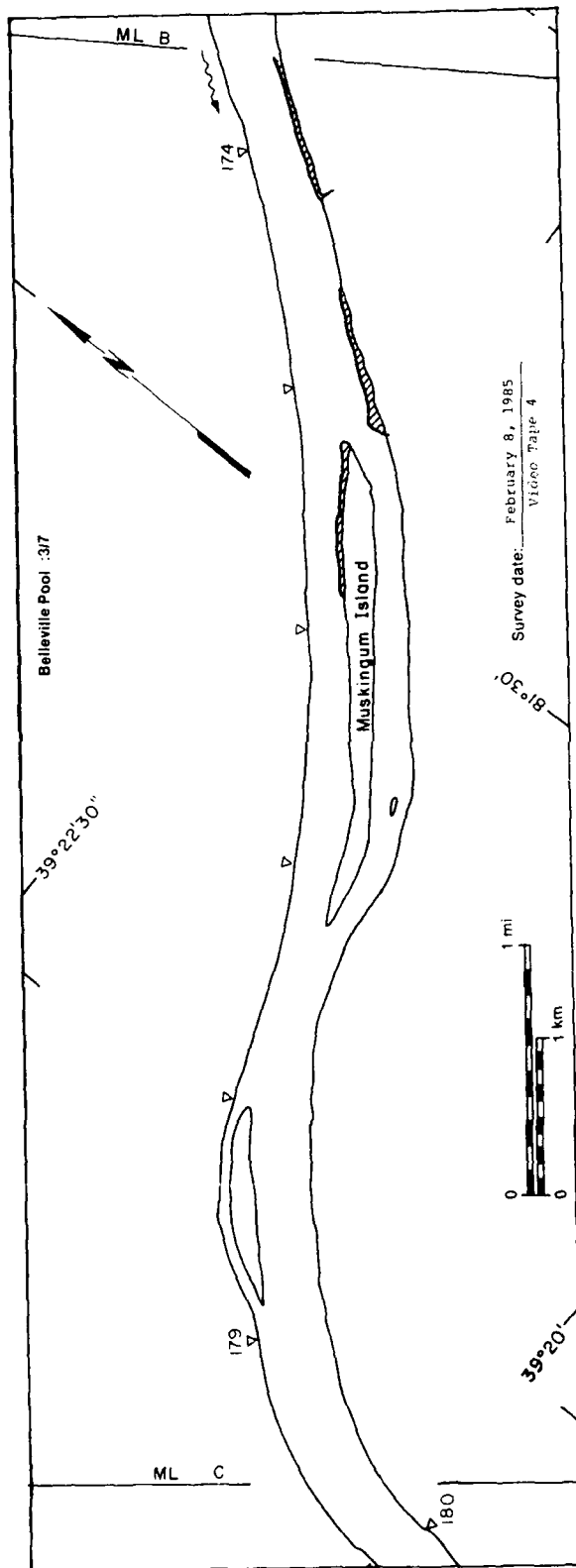
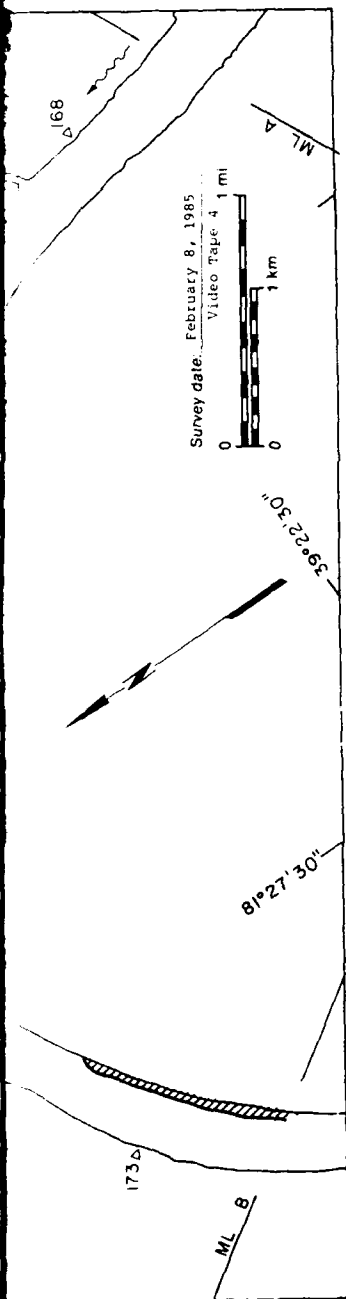


Willow Island Pool

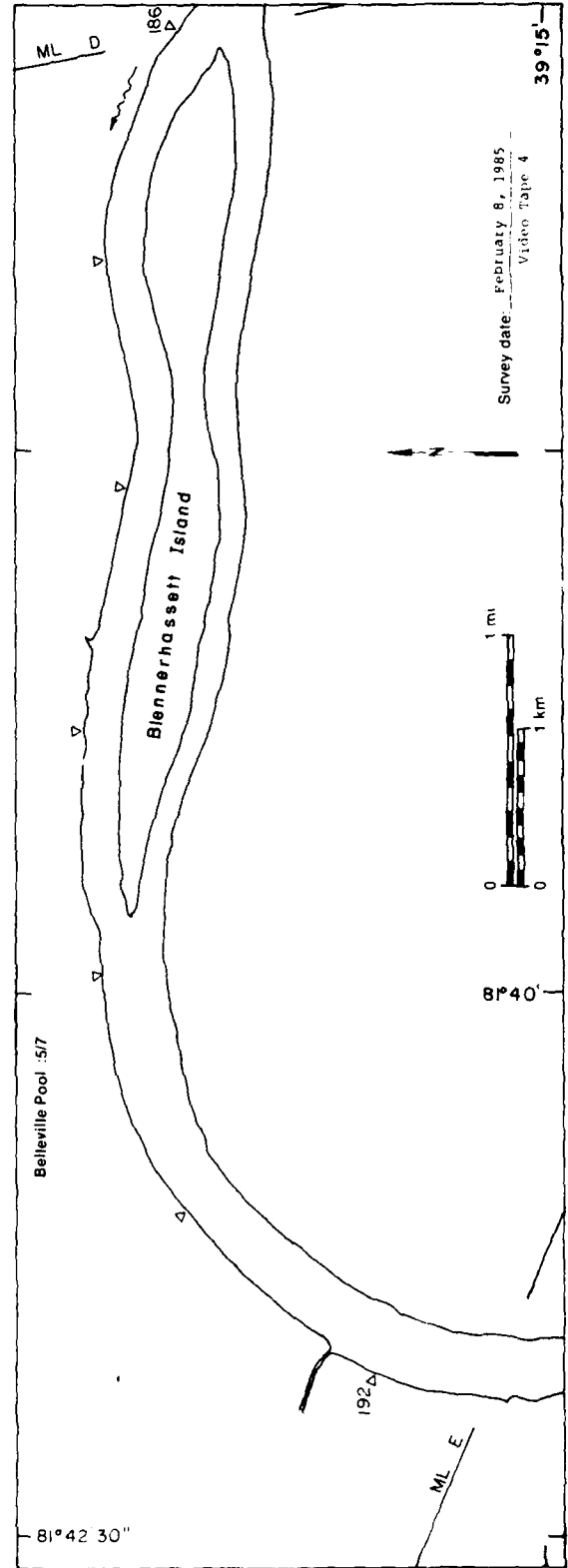
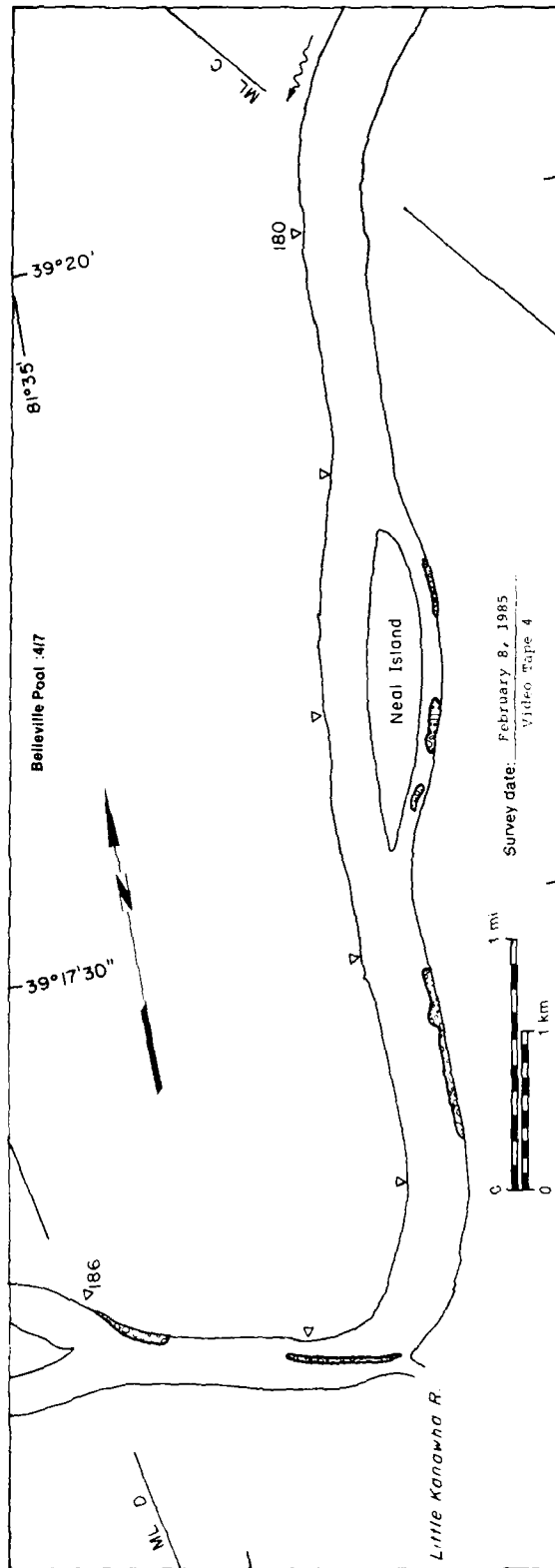
MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	19.39	NA
Solid ice cover	--	NA
Solid ice cover with open water areas	--	--
Fragmented ice cover	0.03	NA
Fragmented ice cover with open water areas	0.95	46
Ice floes or frazil slush and pans	0.87	40
Total Area (m² x 10⁶)	21.24	

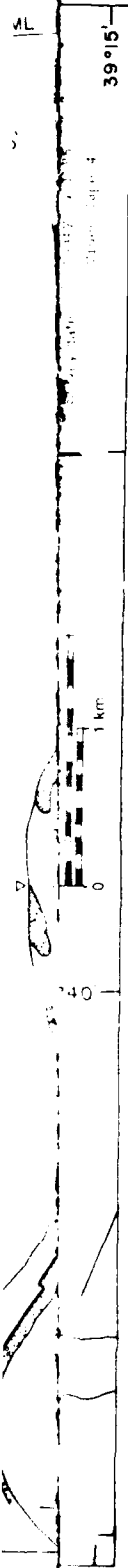
8 February 1985



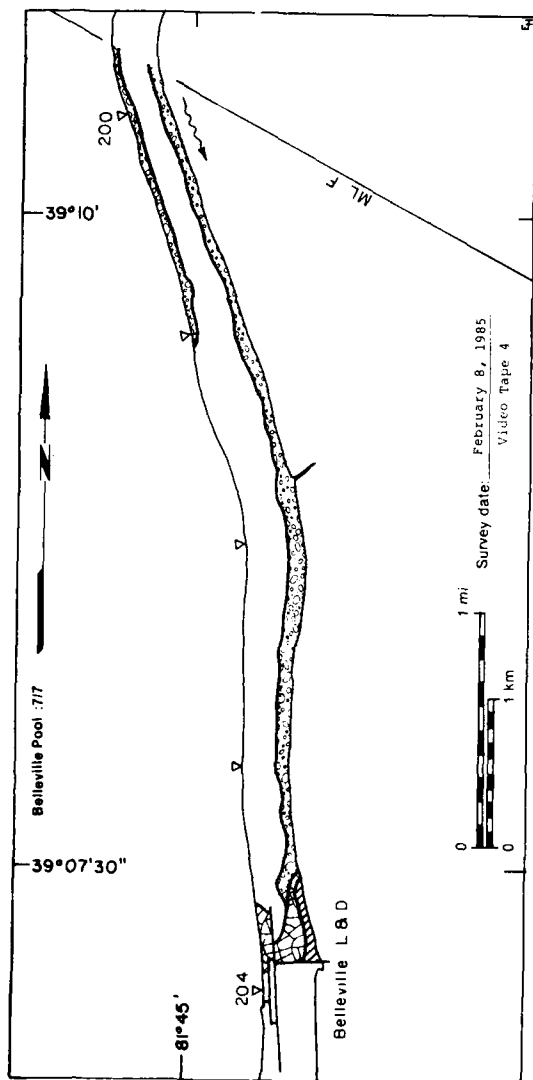


8 February 1985





8 February 1985



Belleville Pool

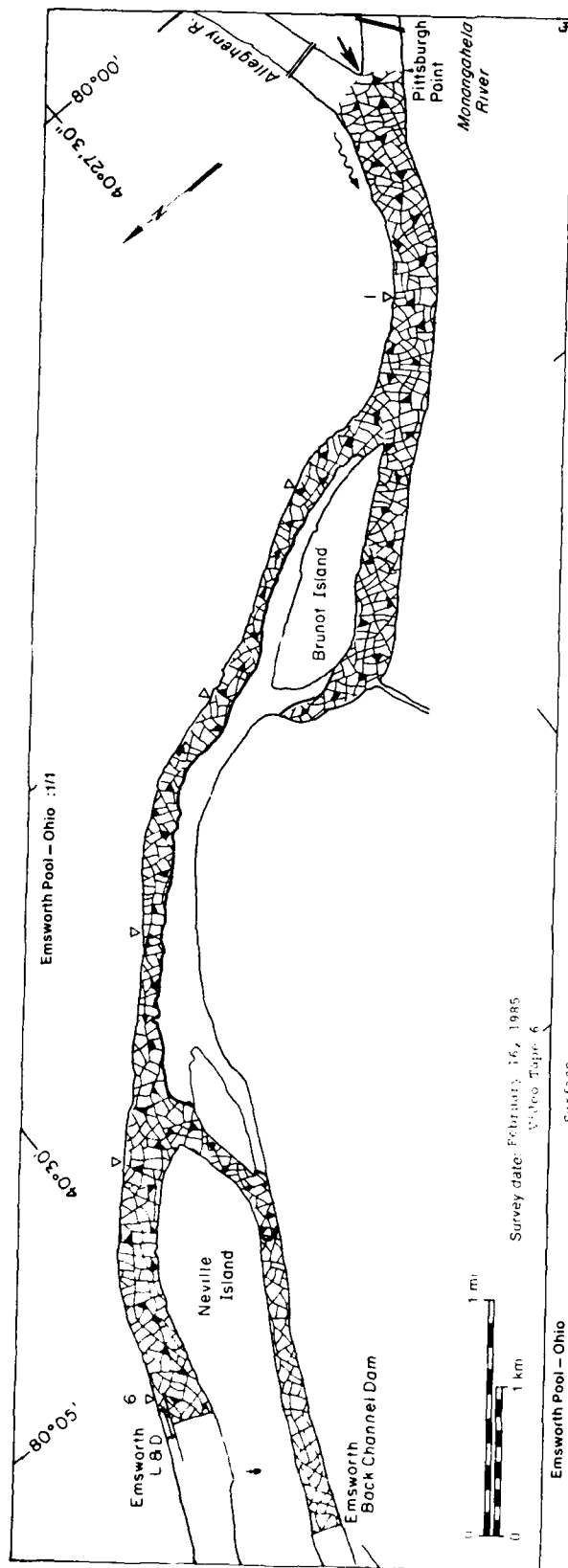
MAP UNITS

- Open water
- Solid ice cover
- Solid ice cover with open-water areas
- Fragmented ice cover
- Fragmented ice cover with open-water areas
- Ice floes or frazil slush and pans

Area 6 (m ² x 10 ⁶)	Surface concentration (%)
24.92	NA
0.31	NA
--	--
0.11	NA
0.37	60
1.57	30
27.28	

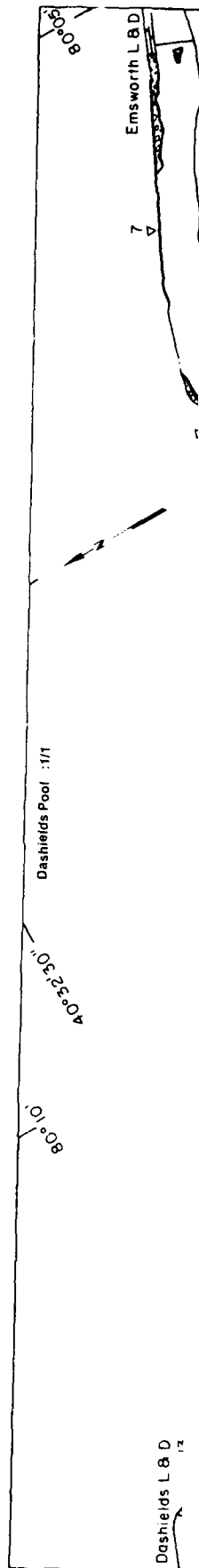
Total Area (m² x 10⁶)

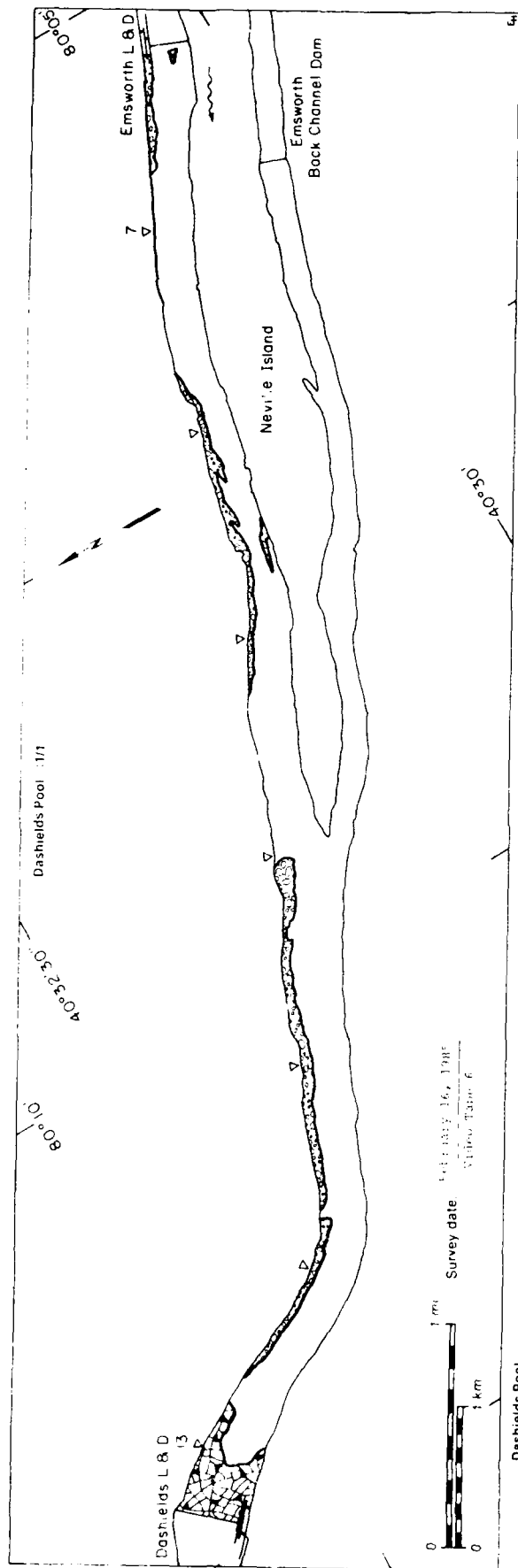
16 February 1985



Emsworth Pool - Ohio

MAP UNITS	Area $(m^2 \times 10^6)$	Surface Concentration (%)
Open water	0.98	NA
Solid ice cover	—	NA
Solid ice cover with open-water areas	—	—
Fragmented ice cover	0.12	NA
Fragmented ice cover with open-water areas	3.19	60
Ice floes or frazil slush and pans	—	—
Total Area $(m^2 \times 10^6)$	4.49	





Dashiels Pool

MAP UNITS

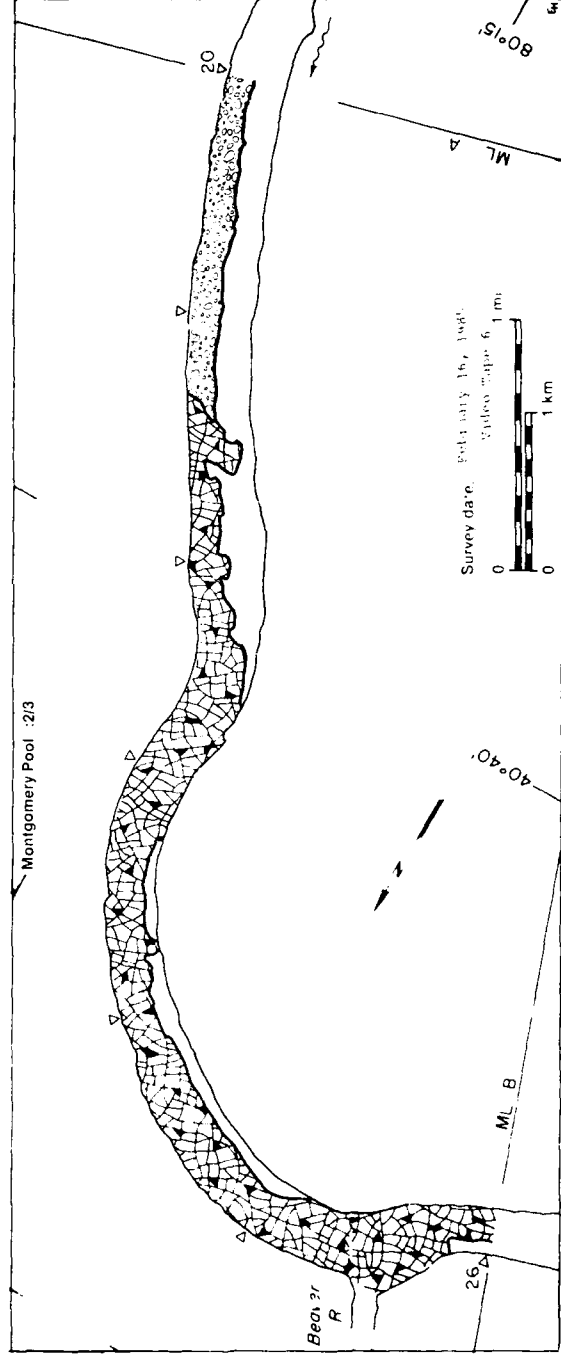
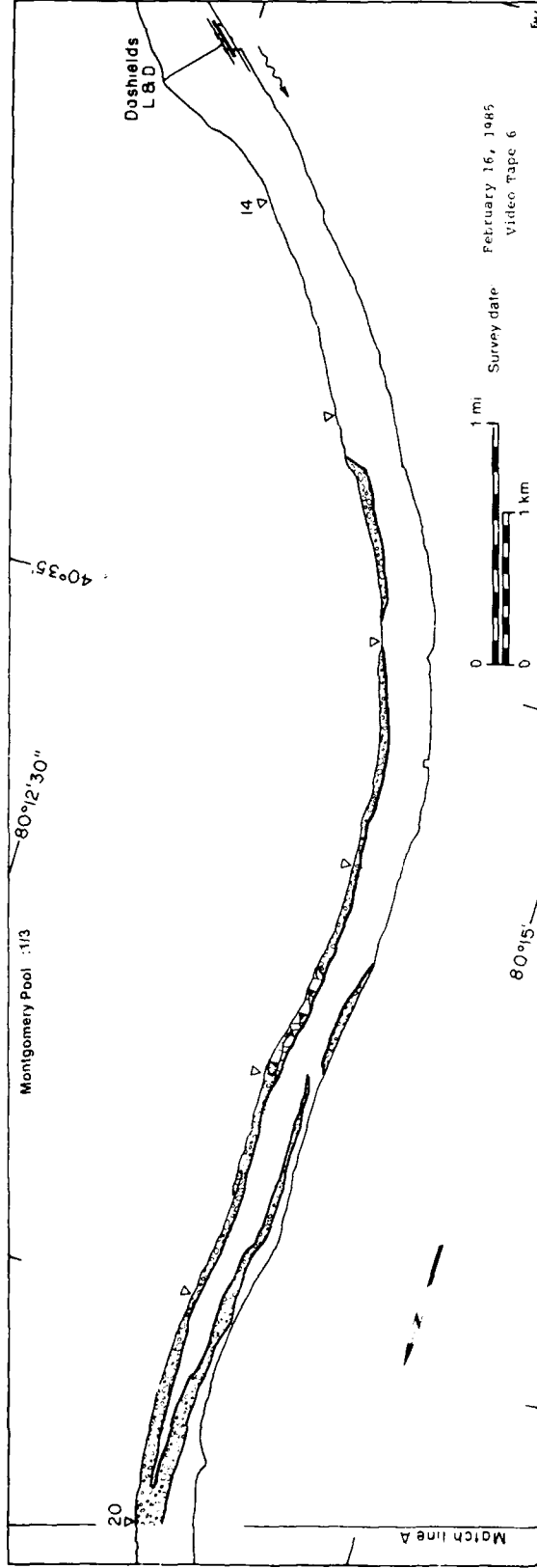
- Open water
- Solid ice cover
- Solid ice cover with open water areas
- Fragmented ice cover
- Fragmented ice cover with open water areas
- Ice floes or trail slush and pans

Surface concentration

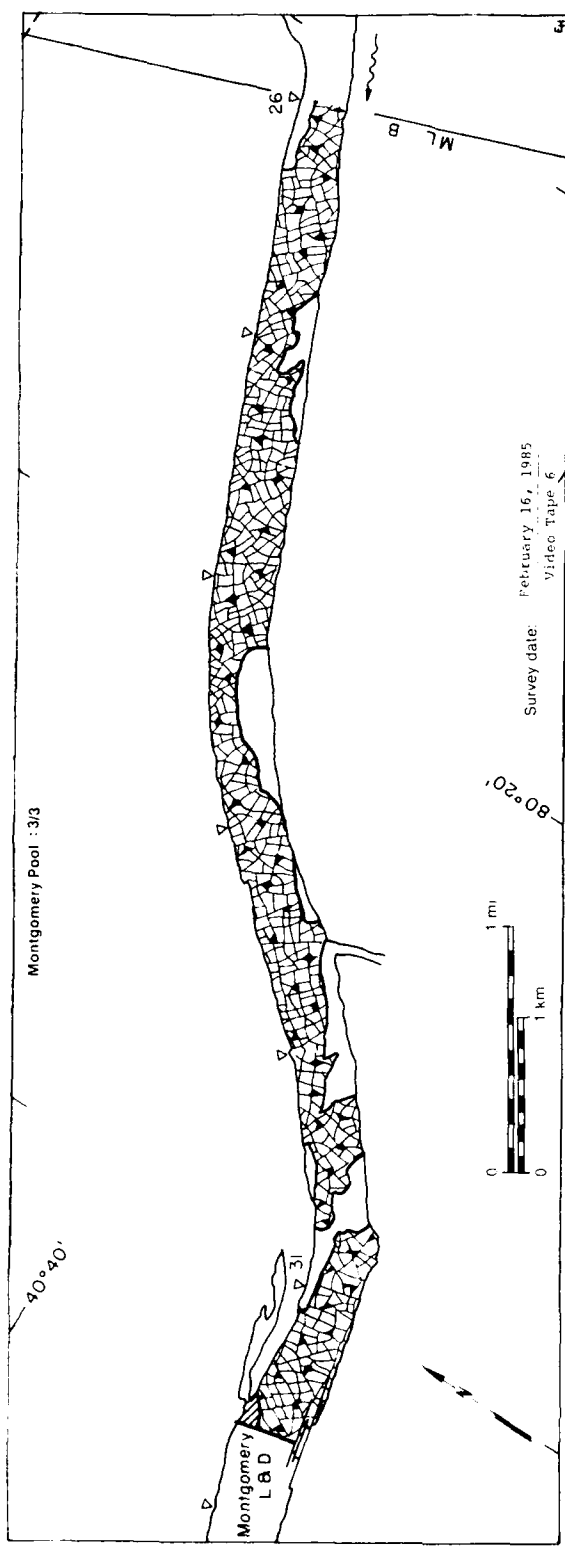
4.3	NA
---	NA
---	---
---	NA
0.26	80
0.51	5
1.00	

Total Area (m² x 10⁶)

16 February 1985



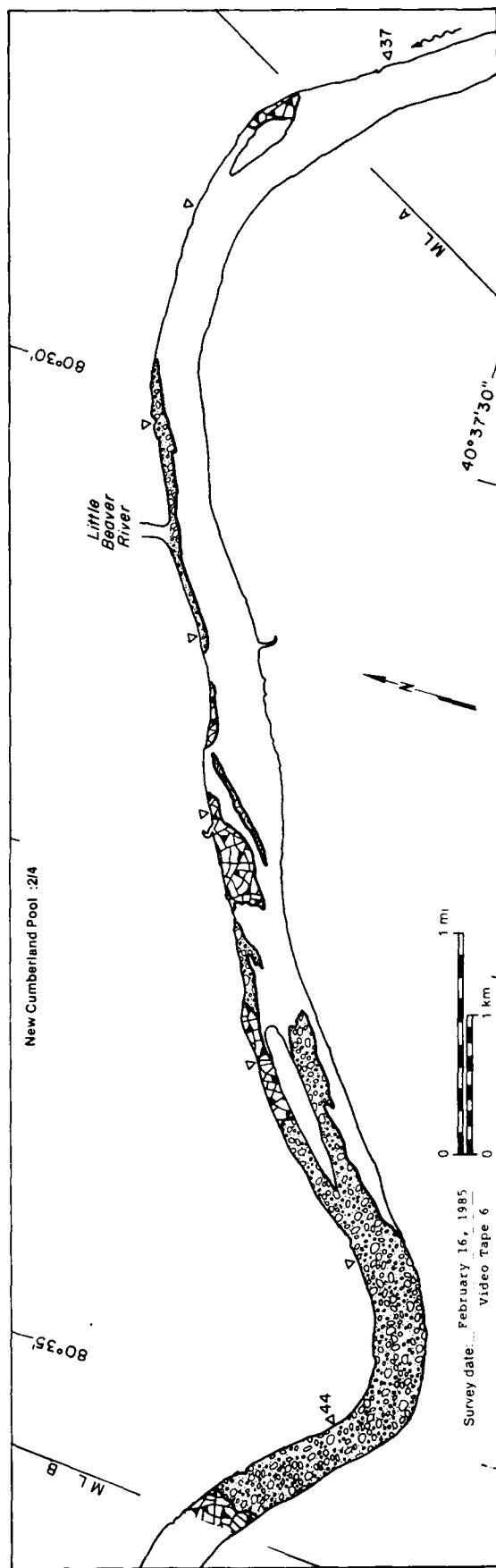
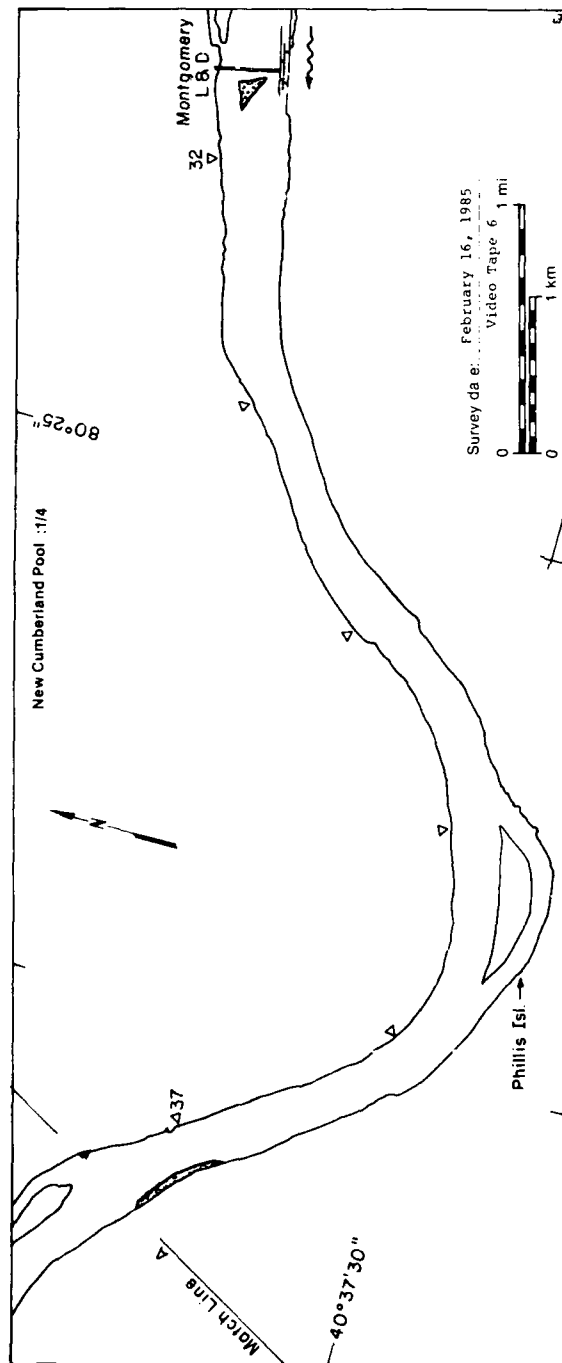
Montgomery Pool :3/3



Survey date: February 16, 1985
Video Tape 6

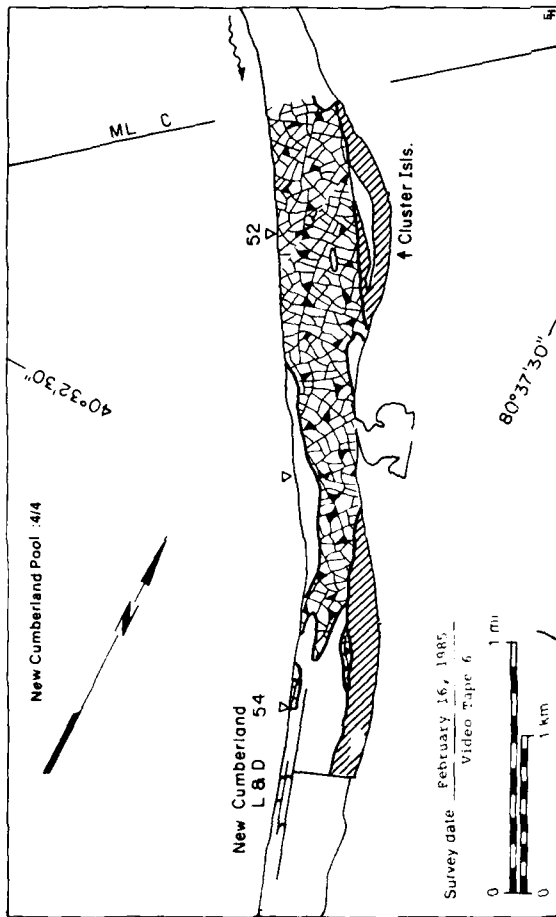
Montgomery Pool		Surface concentration	
MAP UNITS	Area S_1 ($10^2 \times 10^6$)	Area S_2 ($10^2 \times 10^6$)	Concentration (%)
Open water	4.90	NA	NA
Solid ice cover	0.19	NA	NA
Solid ice cover with open water areas	--	--	--
Fragmented ice cover	--	NA	NA
Fragmented ice cover with open water areas	5.19	76	76
Ice floes or hard slush and pans	1.17	5	5
Total Area ($10^2 \times 10^6$)	11.27		

16 February 1985



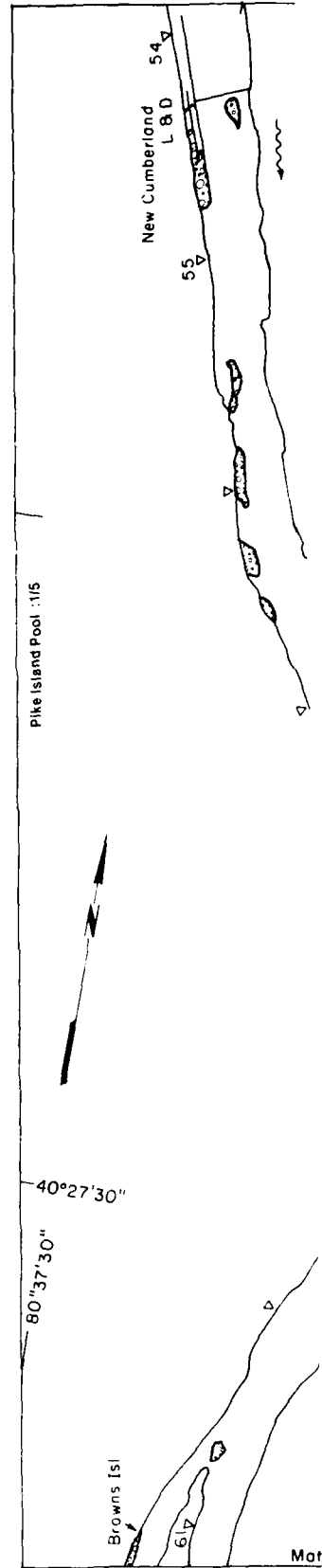
New Cumberland Pool :3/4

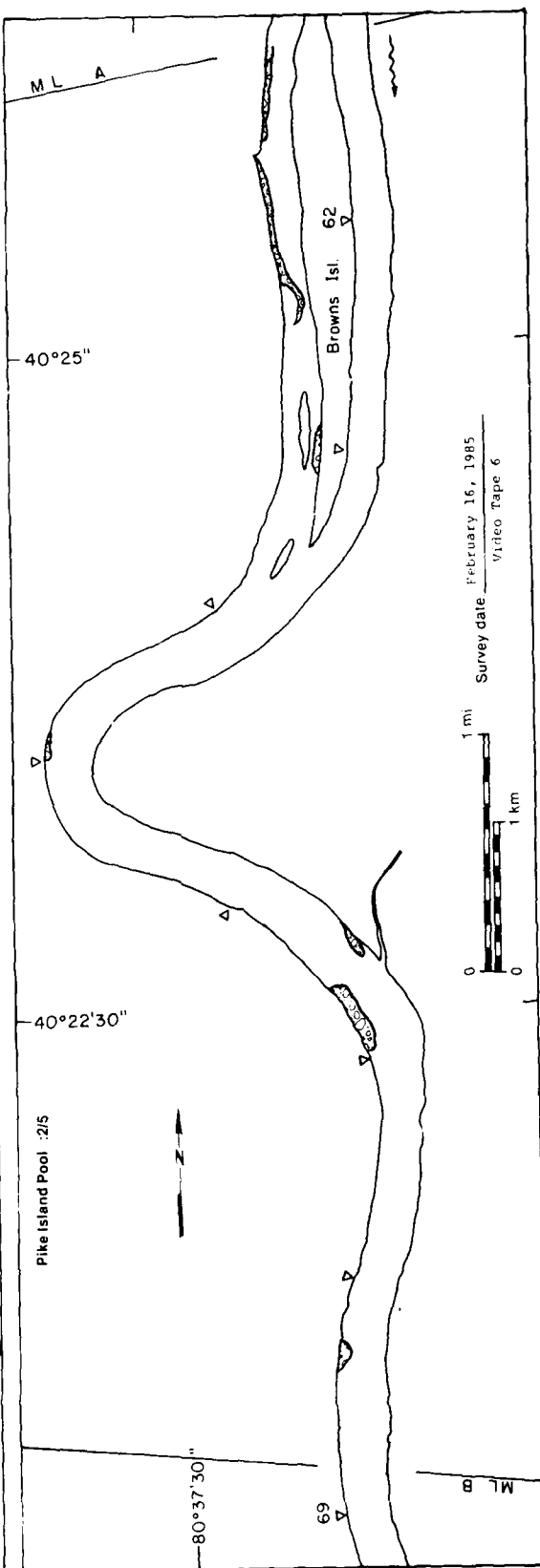
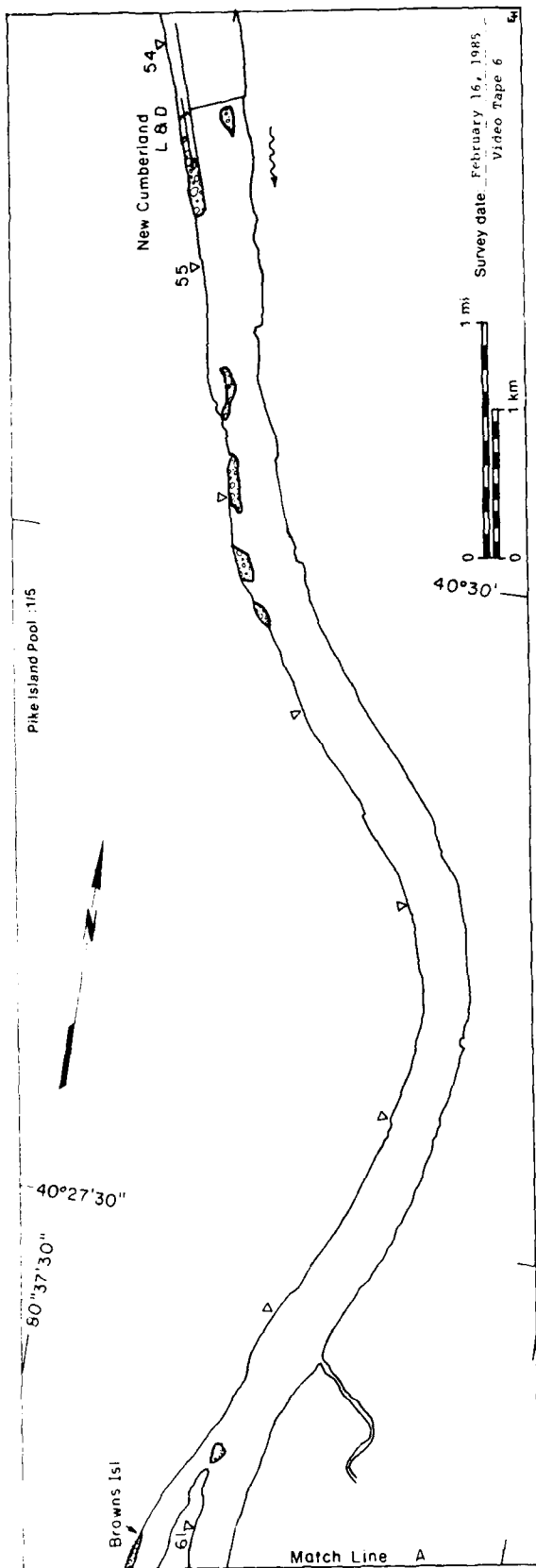
16 February 1985



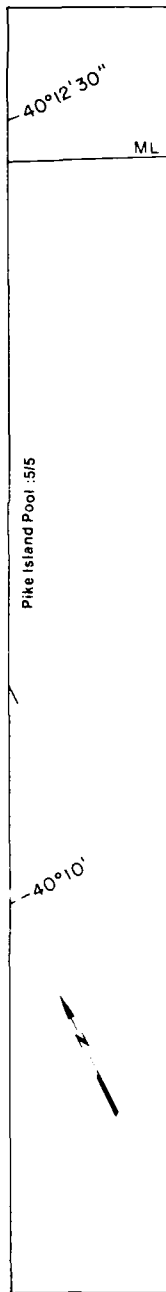
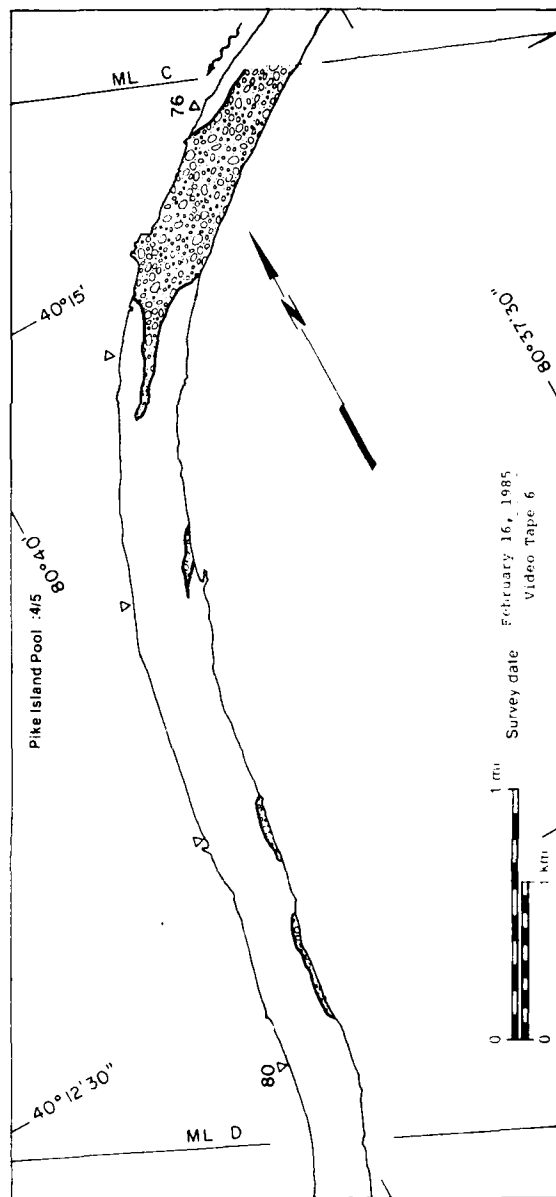
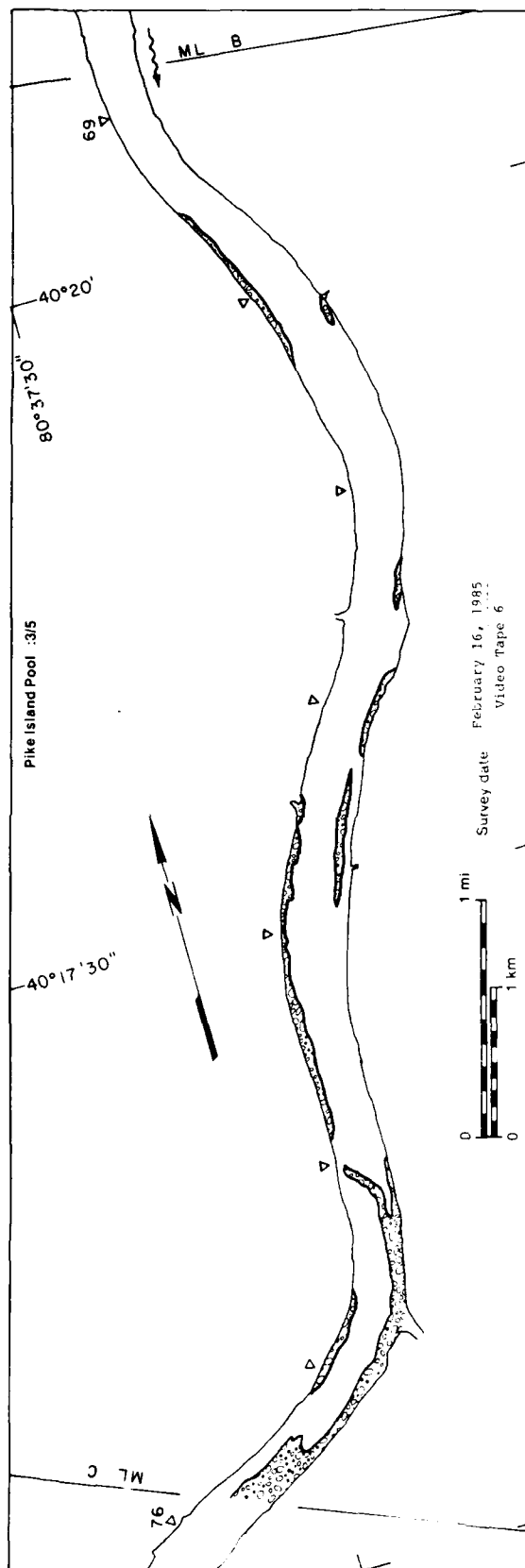
New Cumberland Pool

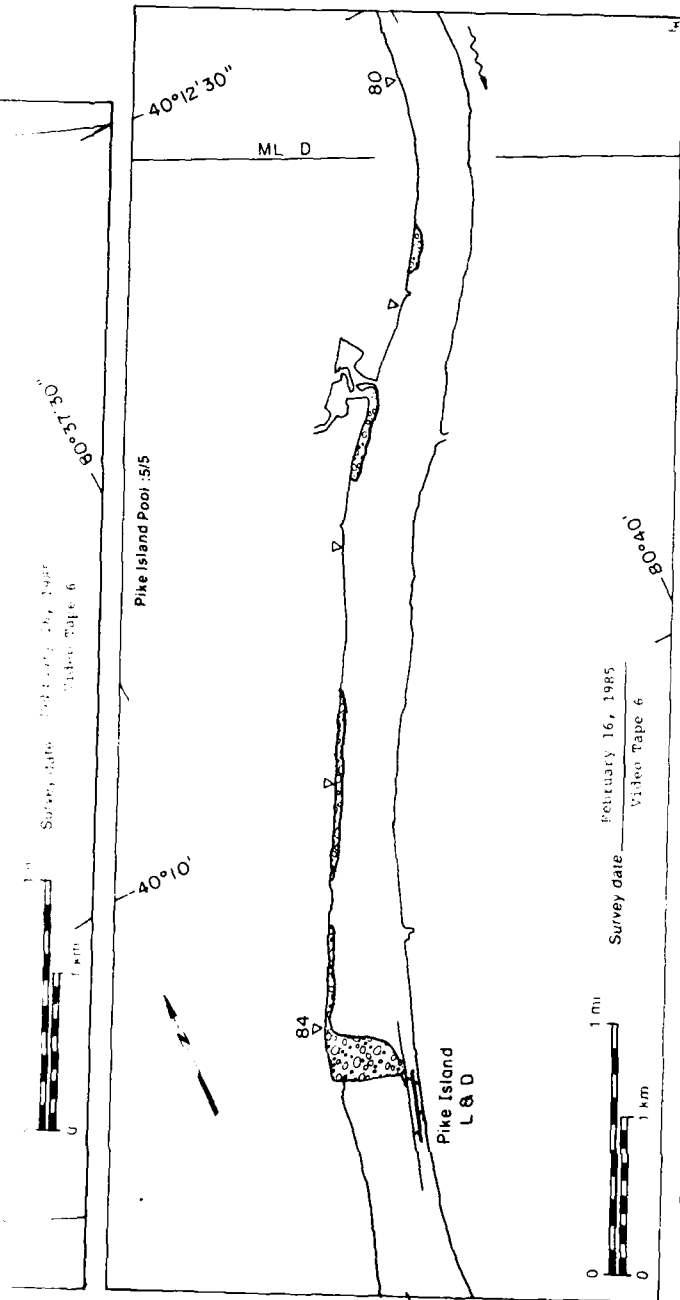
MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	7.63	NA
Solid ice cover	0.45	NA
Solid ice cover with open-water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	5.15	70
Ice floes or frazil slush and pans	1.64	10
Total Area (m ² x 10 ⁶)	14.87	





16 February 1985





Pike Island Pool

MAP UNITS

- Open water
- Solid ice cover
- Solid ice cover with open water areas
- Fragmented ice cover
- Fragmented ice cover with open water areas
- Ice floes or frazil slush and pans

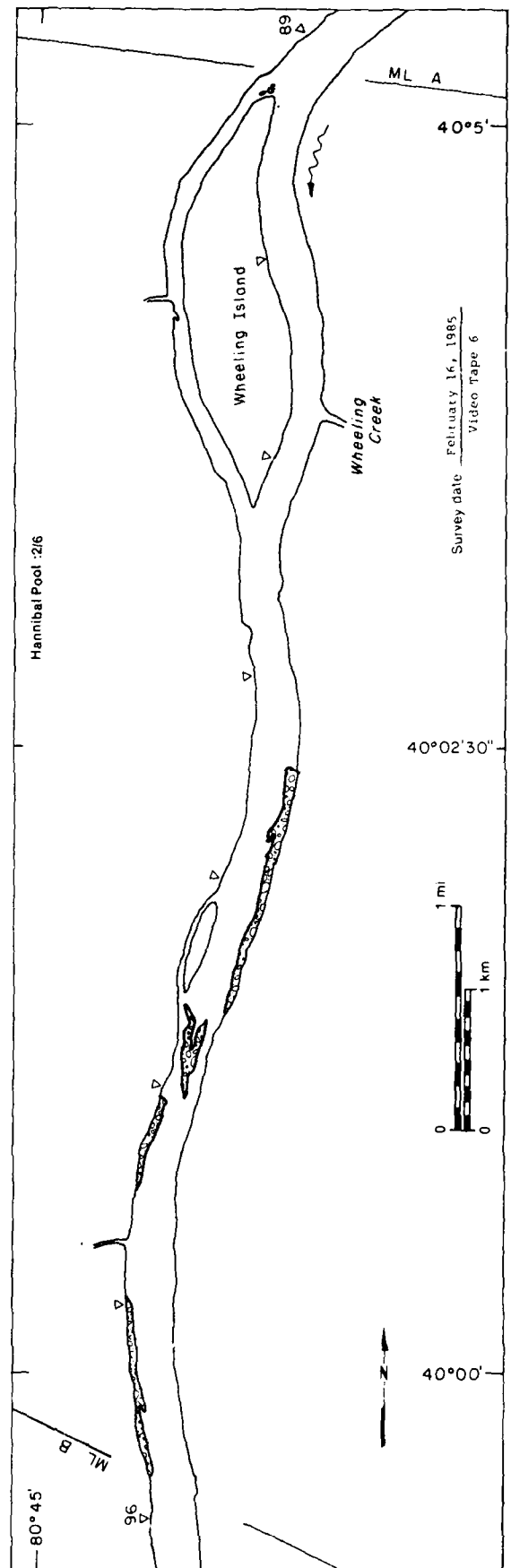
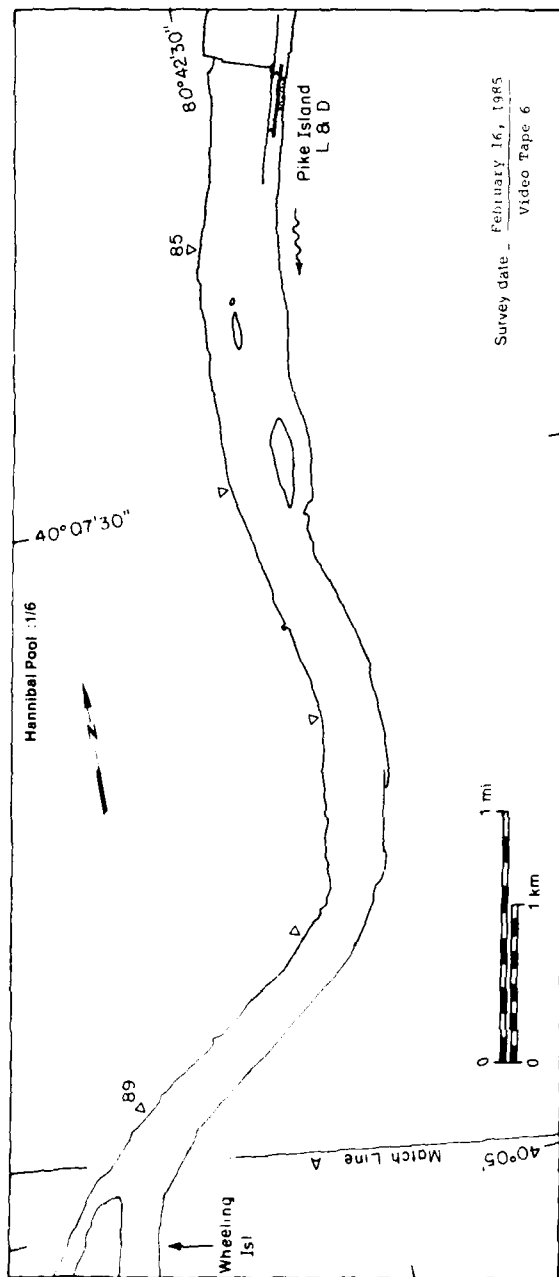
Area (m² x 10⁶)

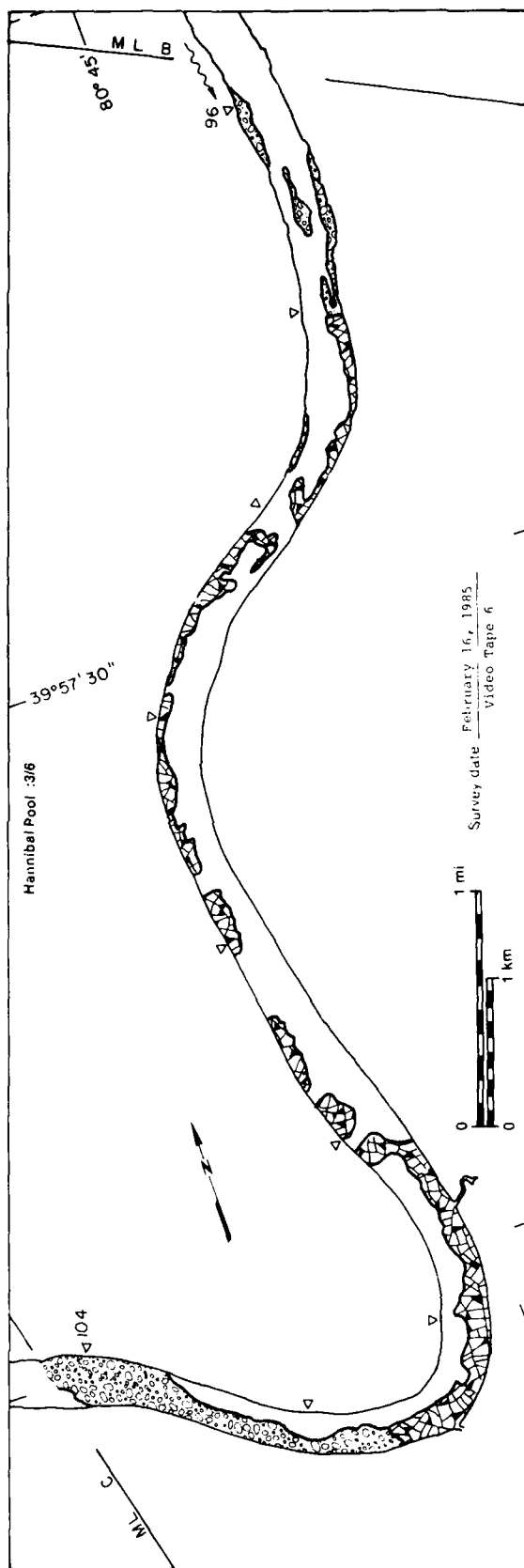
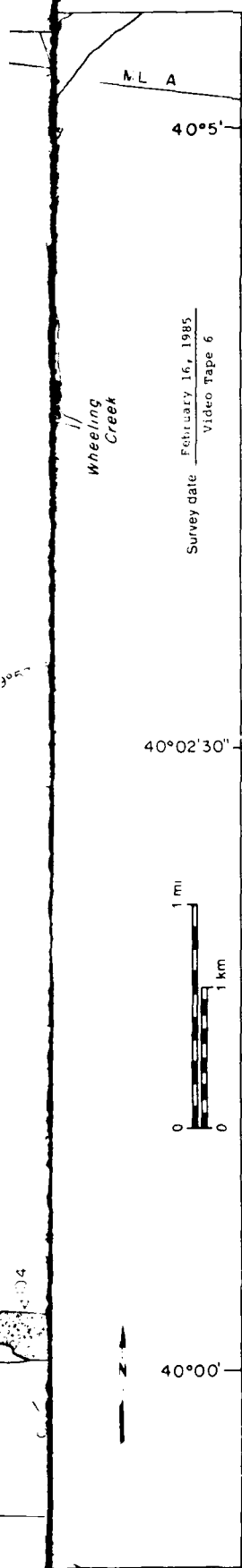
Surface concentration (#)

16.91	NA
---	NA
---	---
---	NA
---	---
1.99	5
18.92	

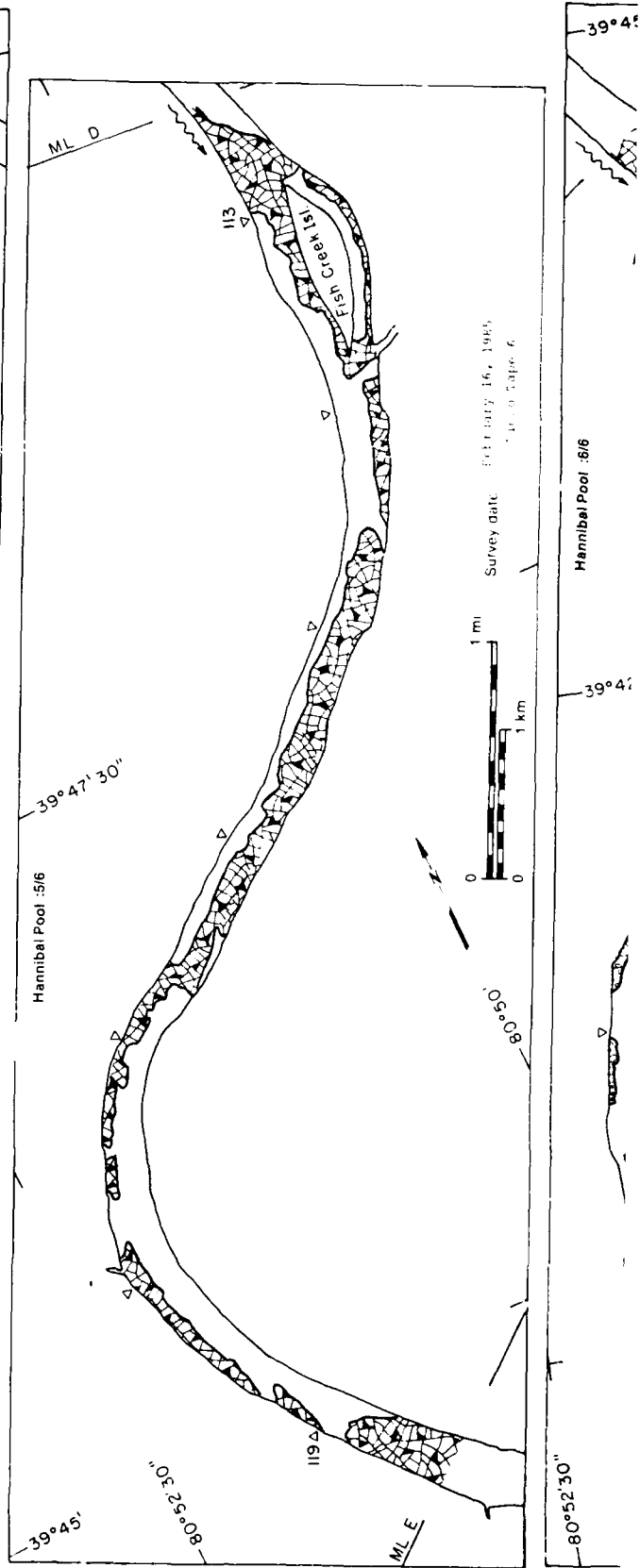
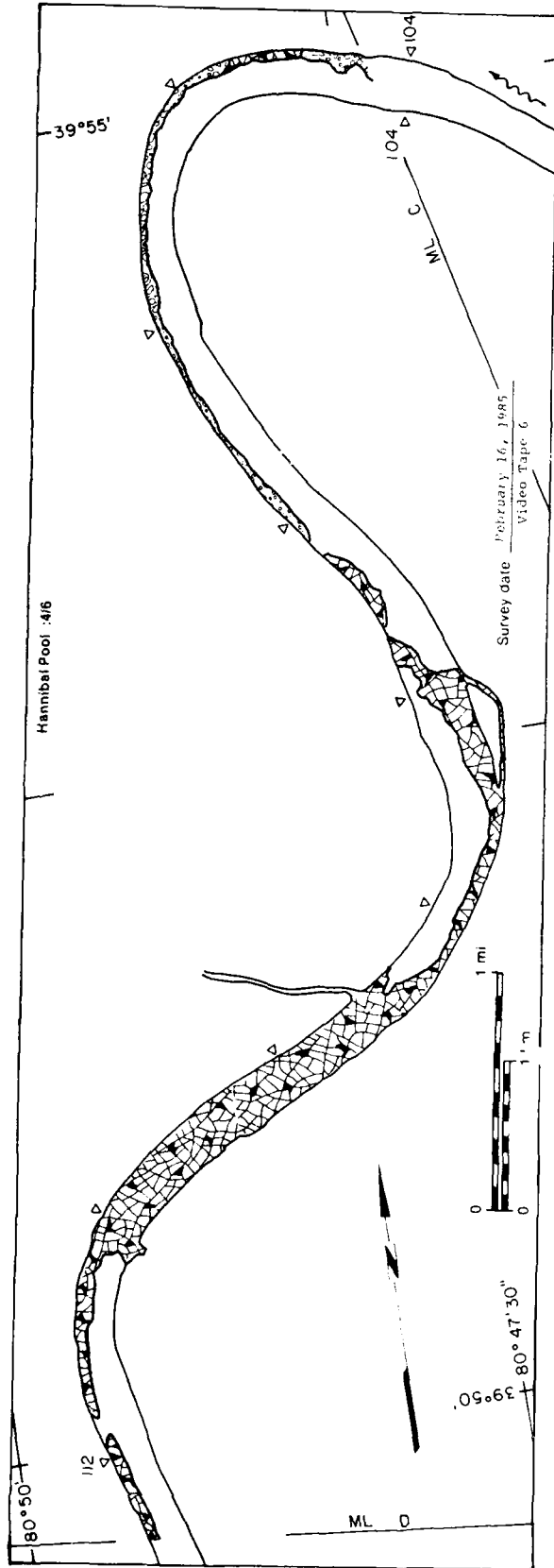
Total Area (m² x 10⁶)

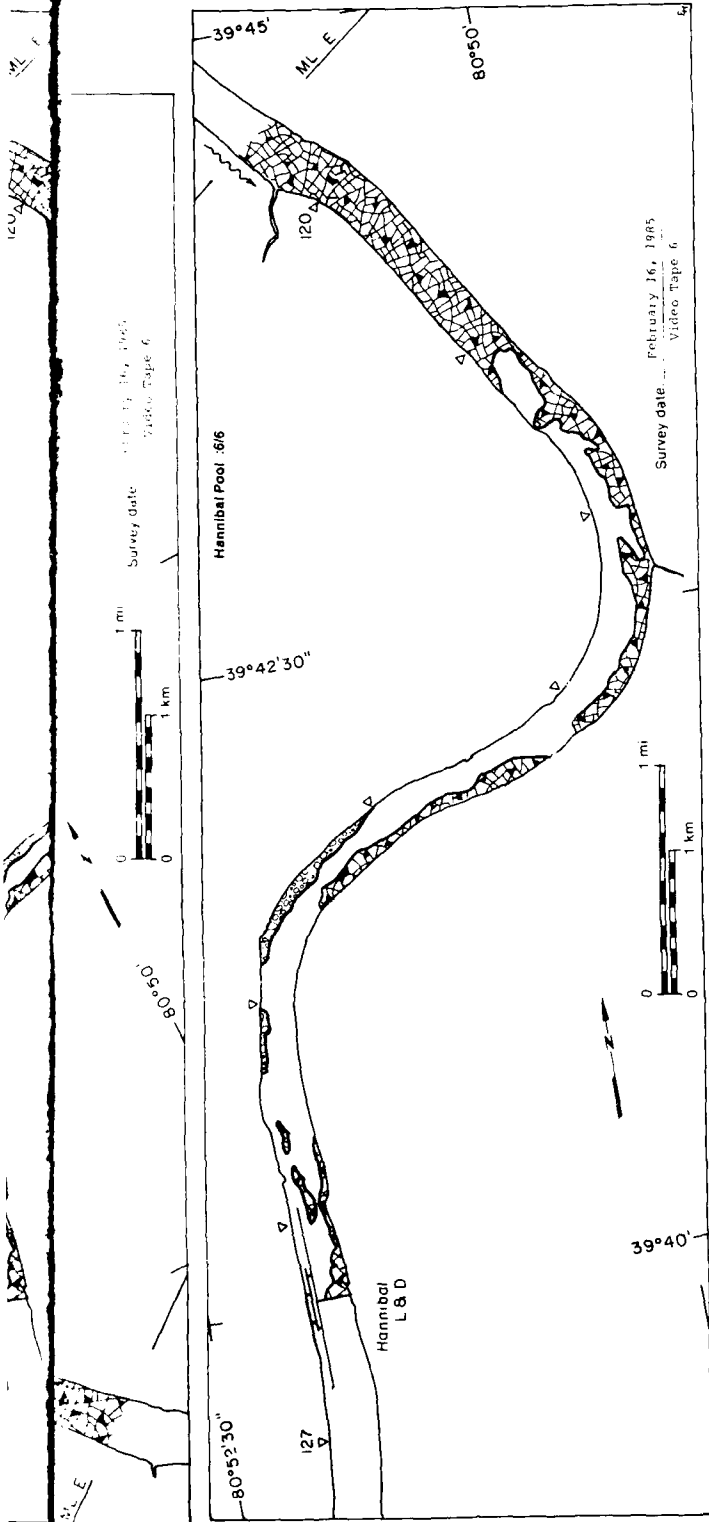
16 February 1985





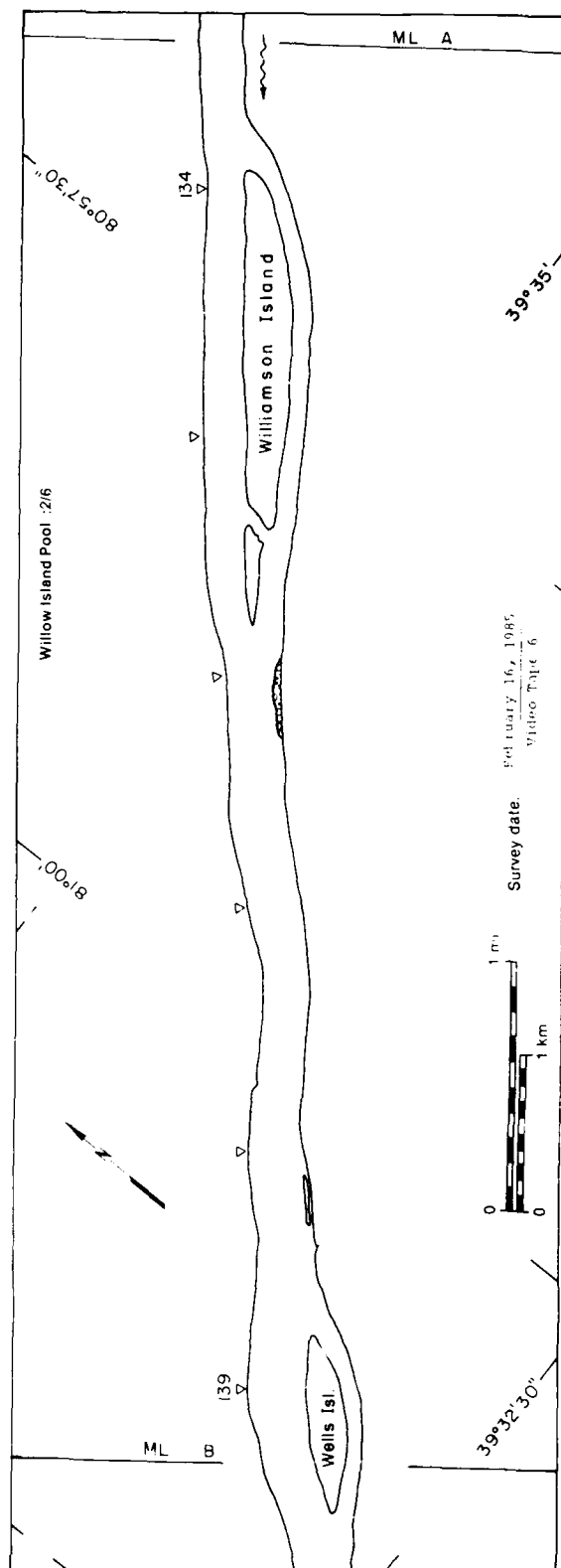
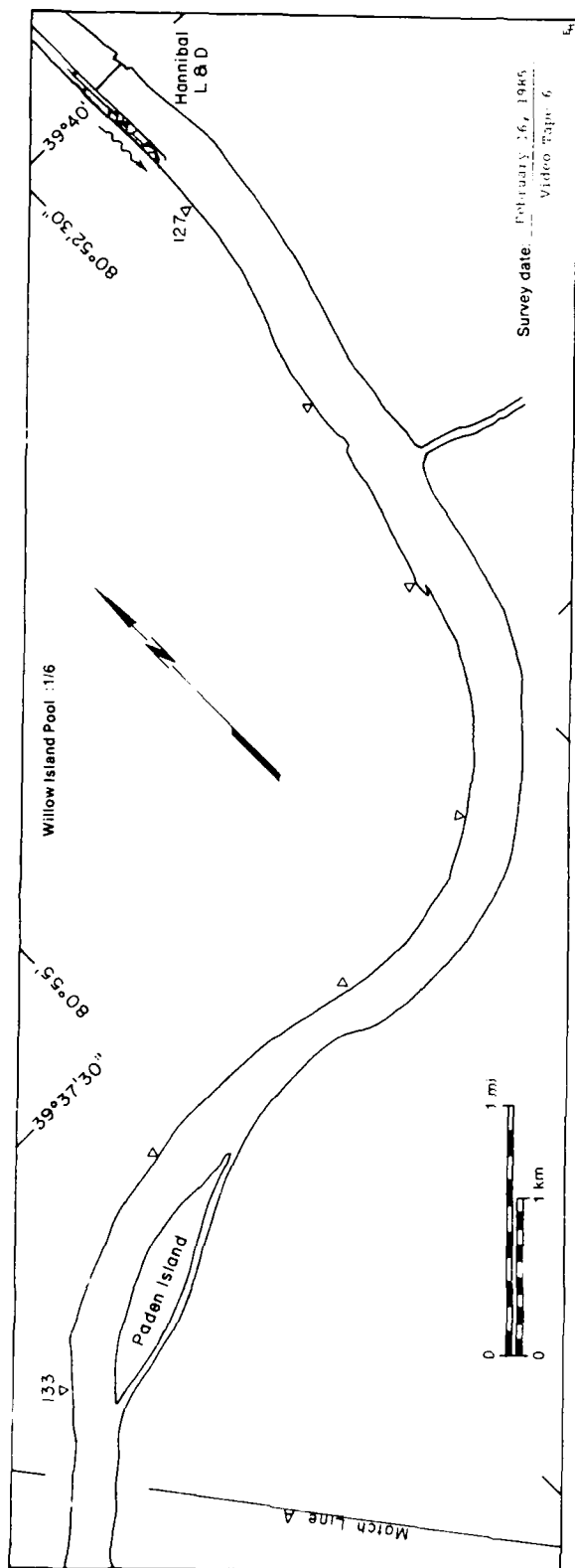
16 February 1985

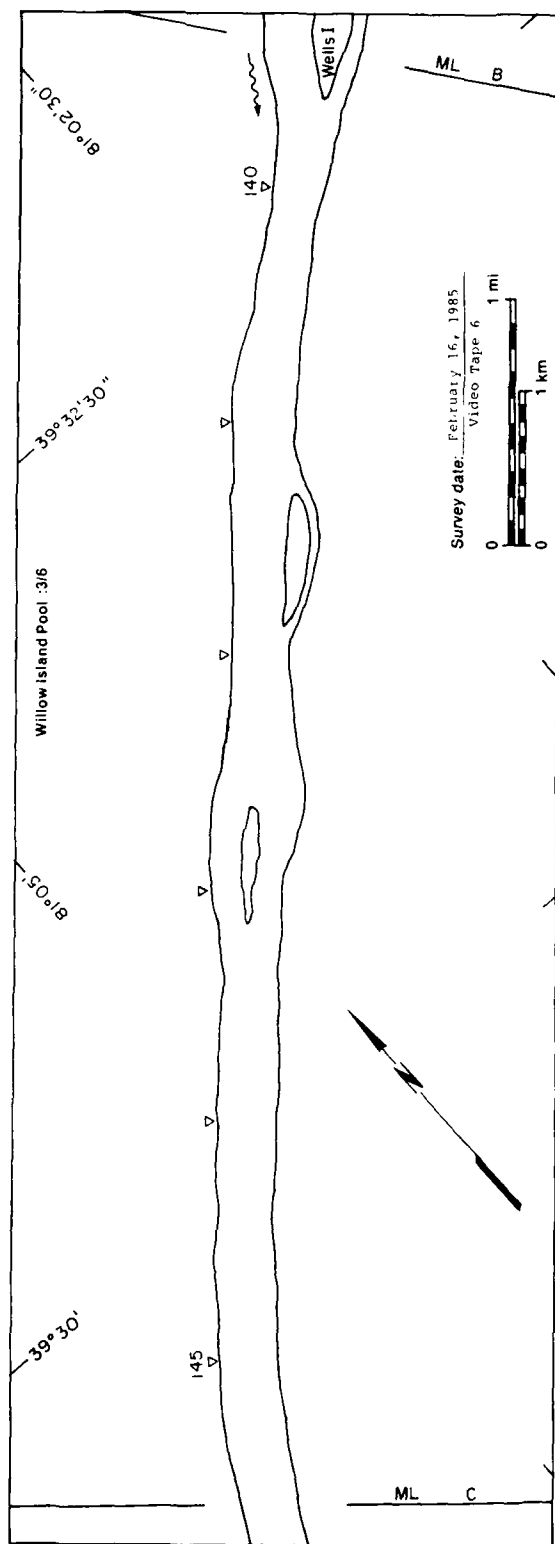
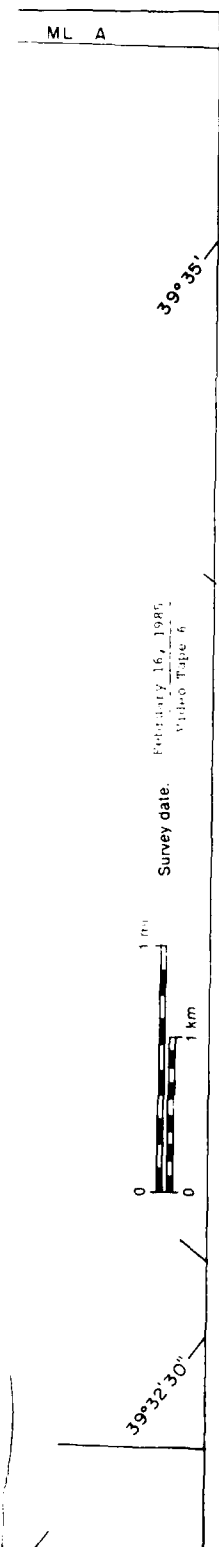




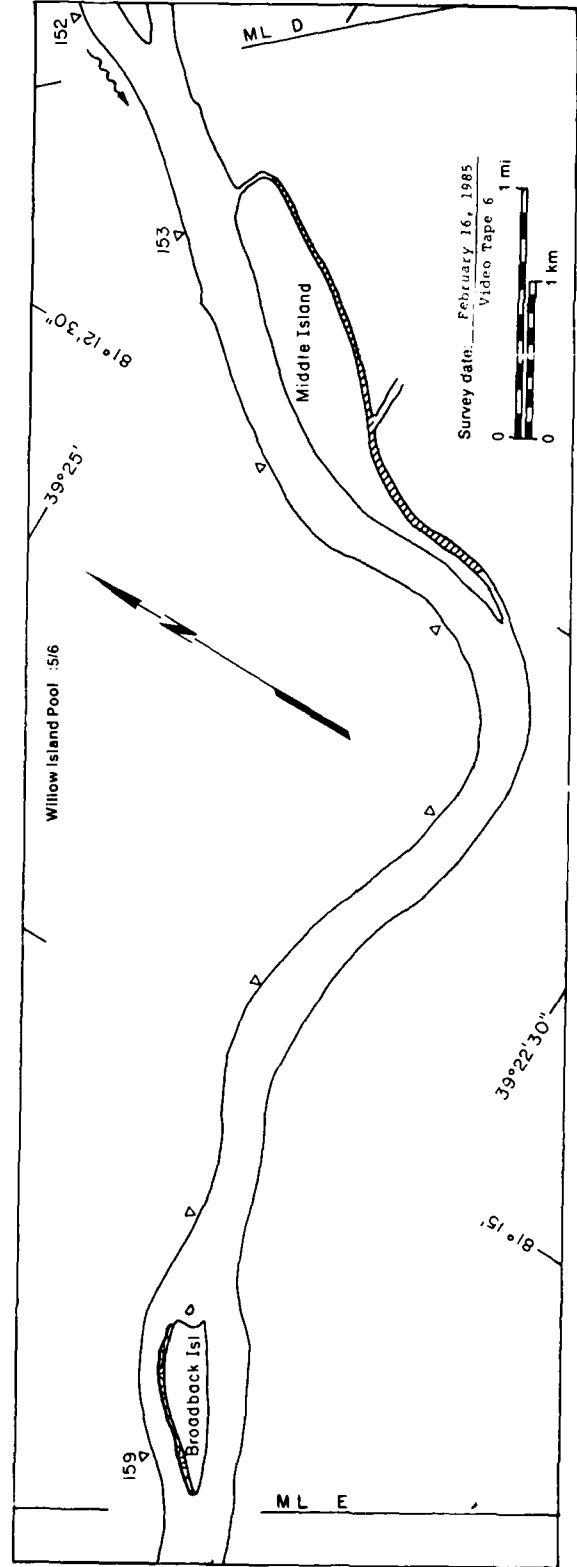
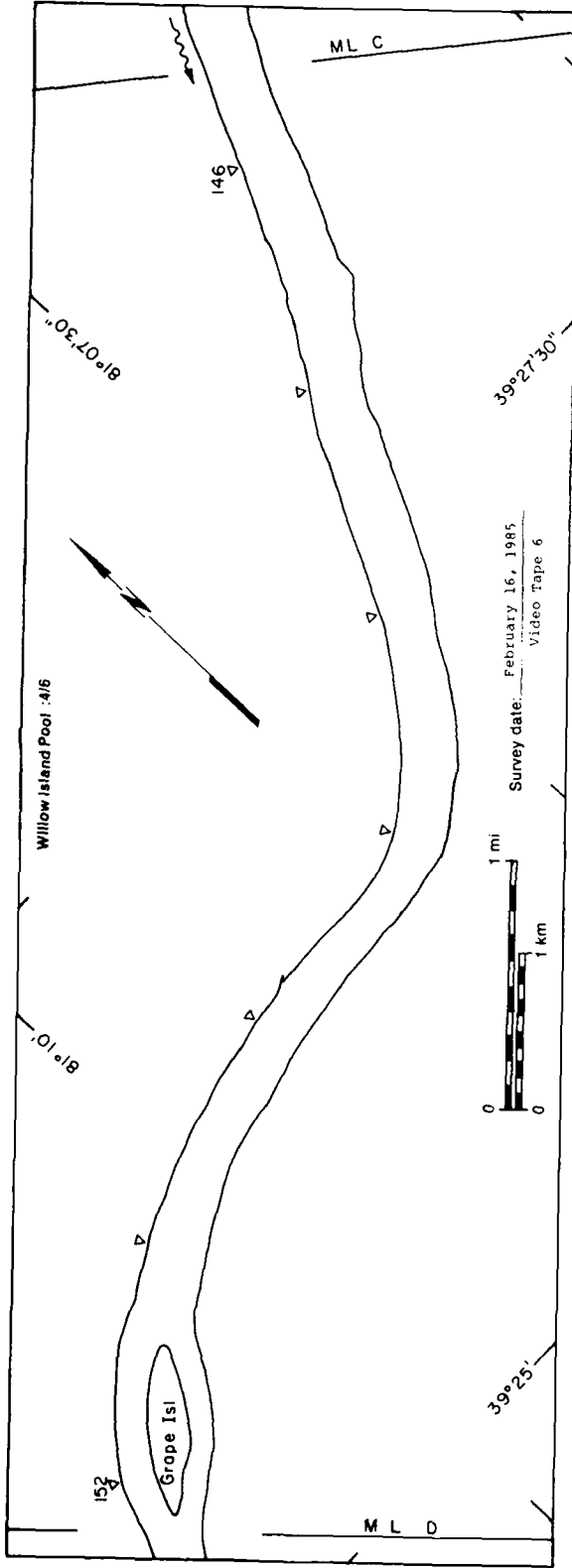
Hannibal Pool		Surface concentration (%)
MAP UNITS	Area (m ² x 10 ⁶)	
Open water	15.33	NA
Solid ice cover	--	NA
Solid ice cover with open water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open water areas	5.84	50
Ice holes or frazil slush and pans	1.29	10
Total Area (m ² x 10 ⁶)		23.46

16 February 1985





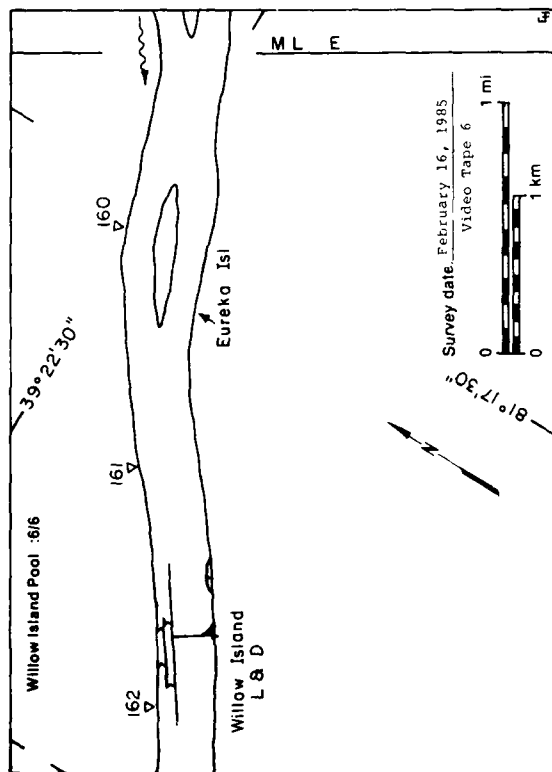
16 February 1985



Willow Island Pool
MAP UNITS
Surface
contour interval
10'

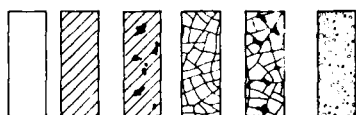
Willow Island Pool
MAP UNITS

Willow Island Pool 6/6
39°22'30"



Willow Island Pool

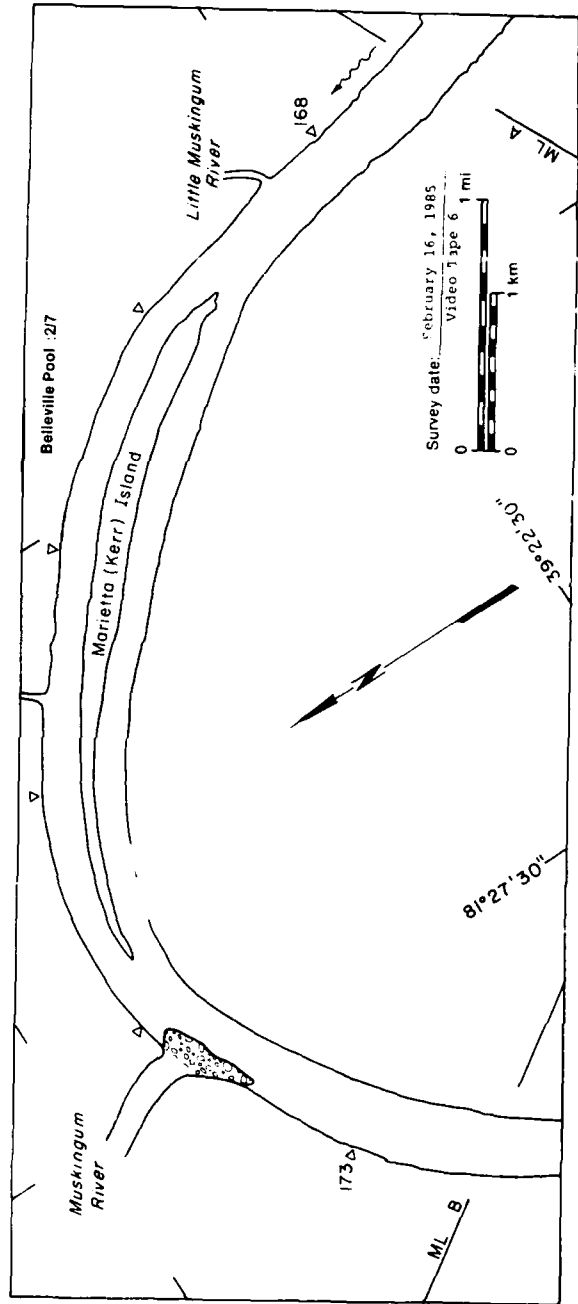
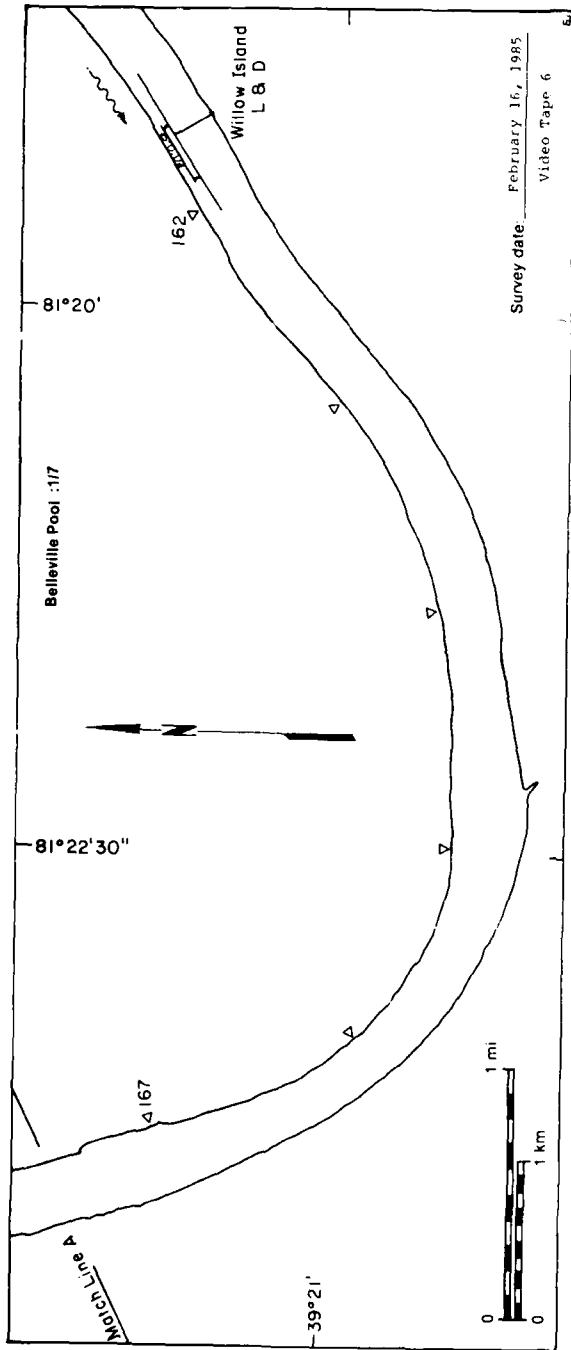
MAP UNITS



Area $(m^2 \times 10^6)$	Surface concentration (%)
20.99	NA
0.16	NA
--	--
0.04	NA
0.03	30
0.02	10
21.24	

Total Area $(m^2 \times 10^6)$

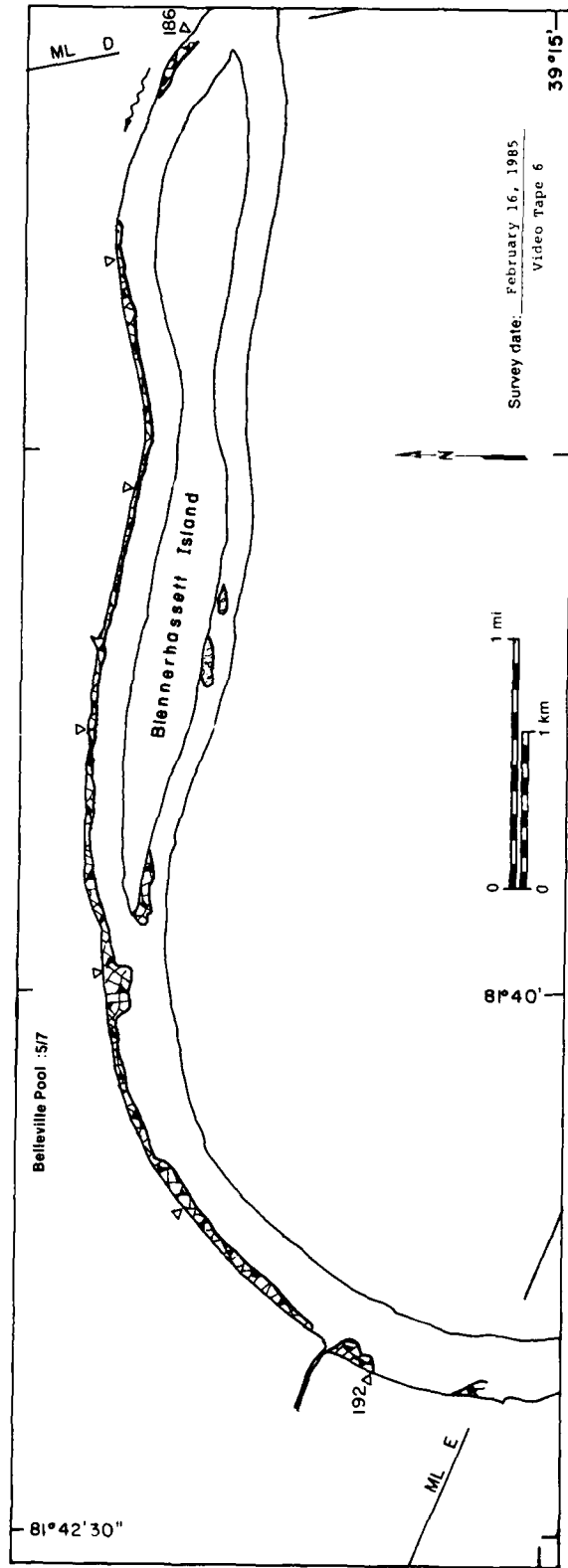
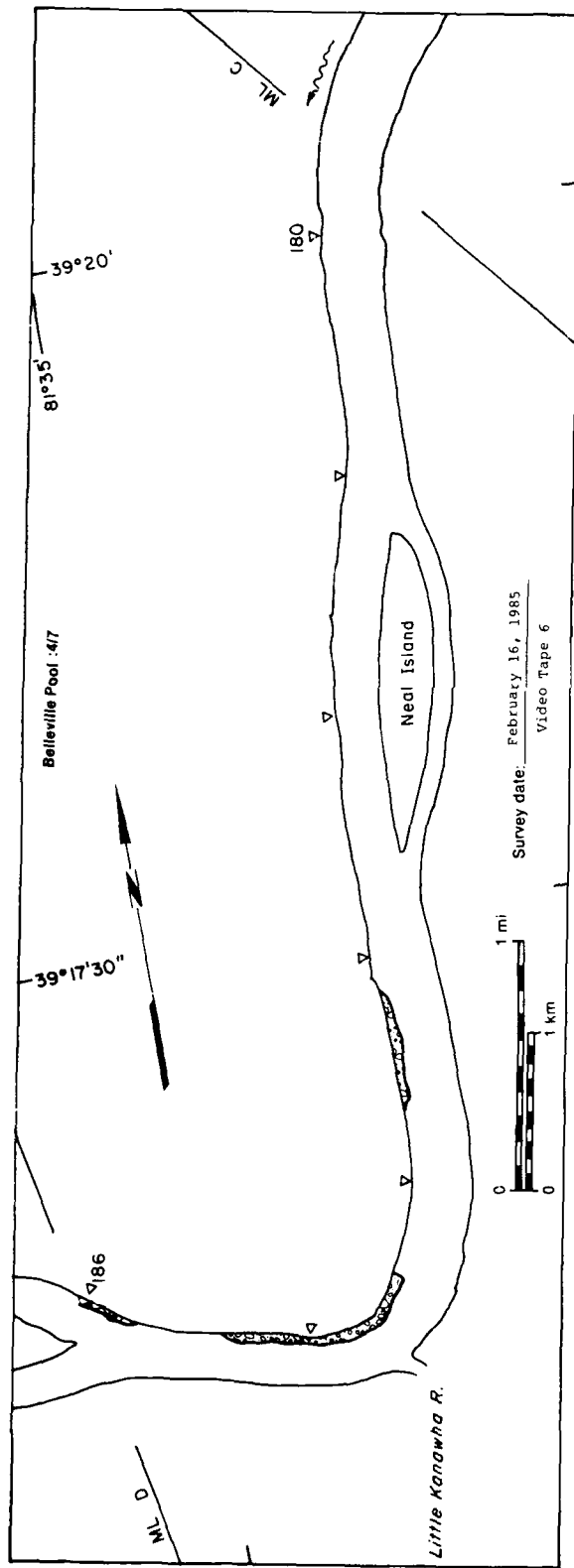
16 February 1985

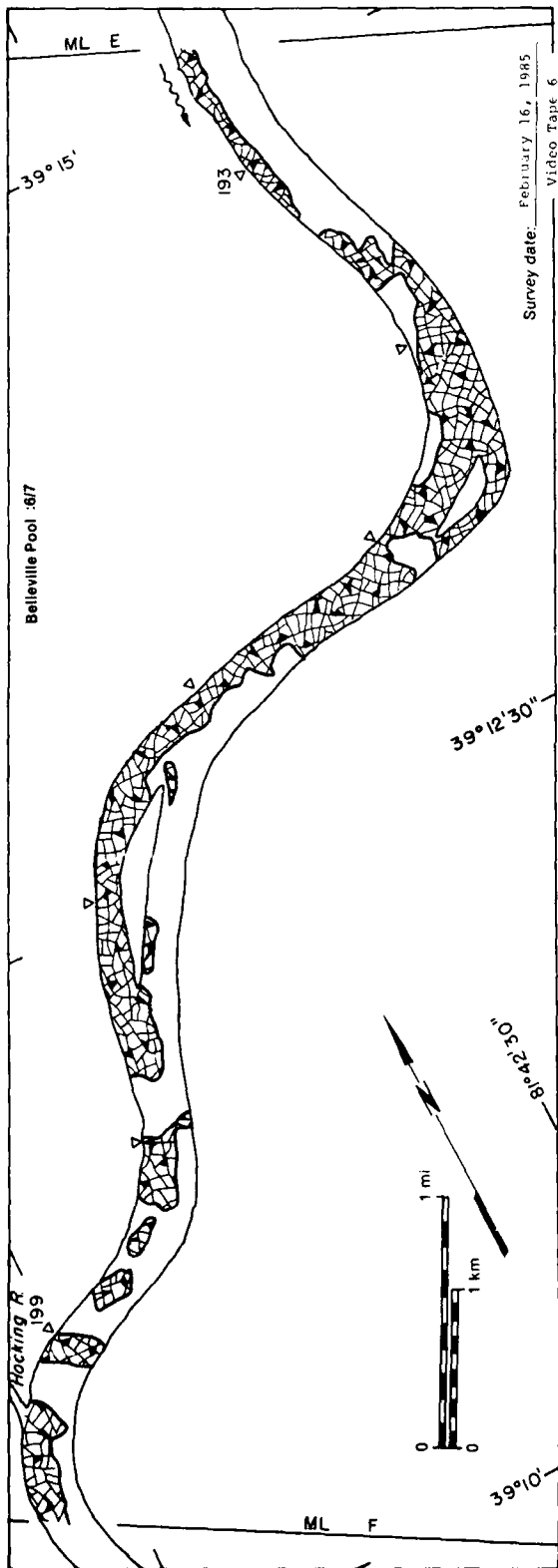
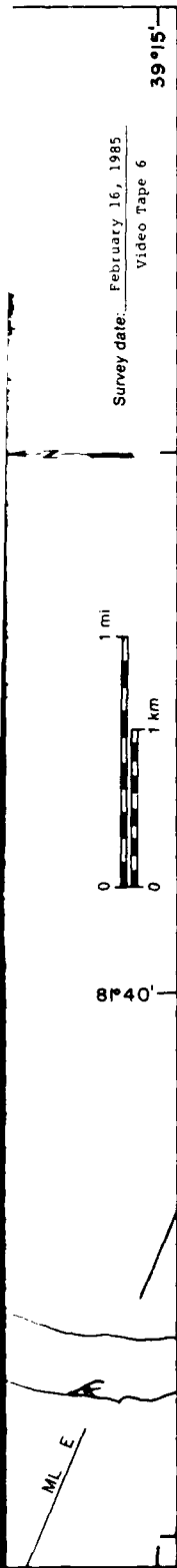


Belleville Pool :37

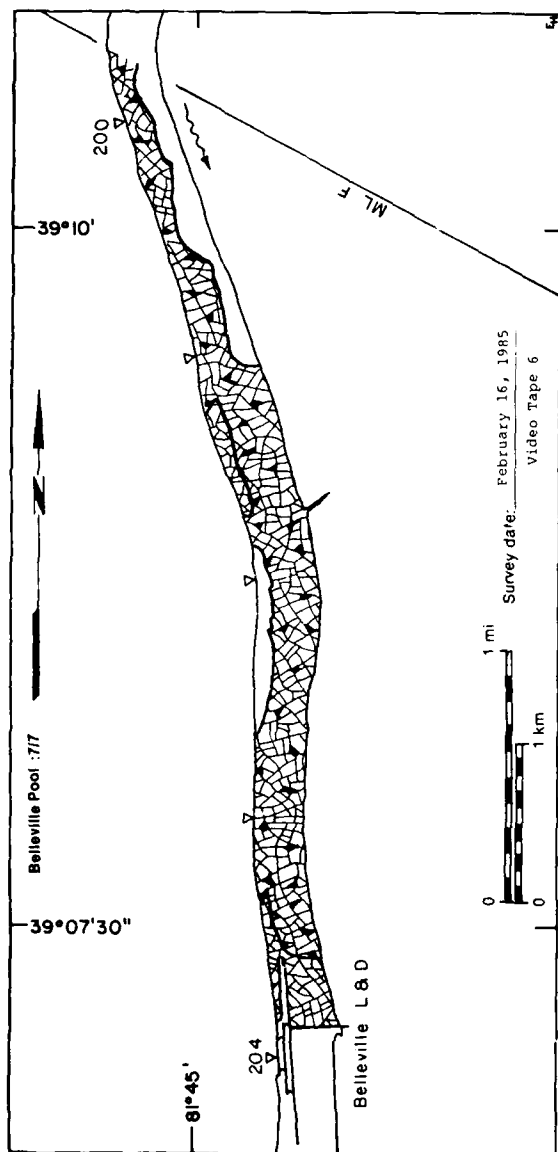
$39^{\circ}22'31''$

16 February 1985





16 February 1985



Survey date: February 16, 1985
Video Tape 6

Belleville Pool

MAP UNITS

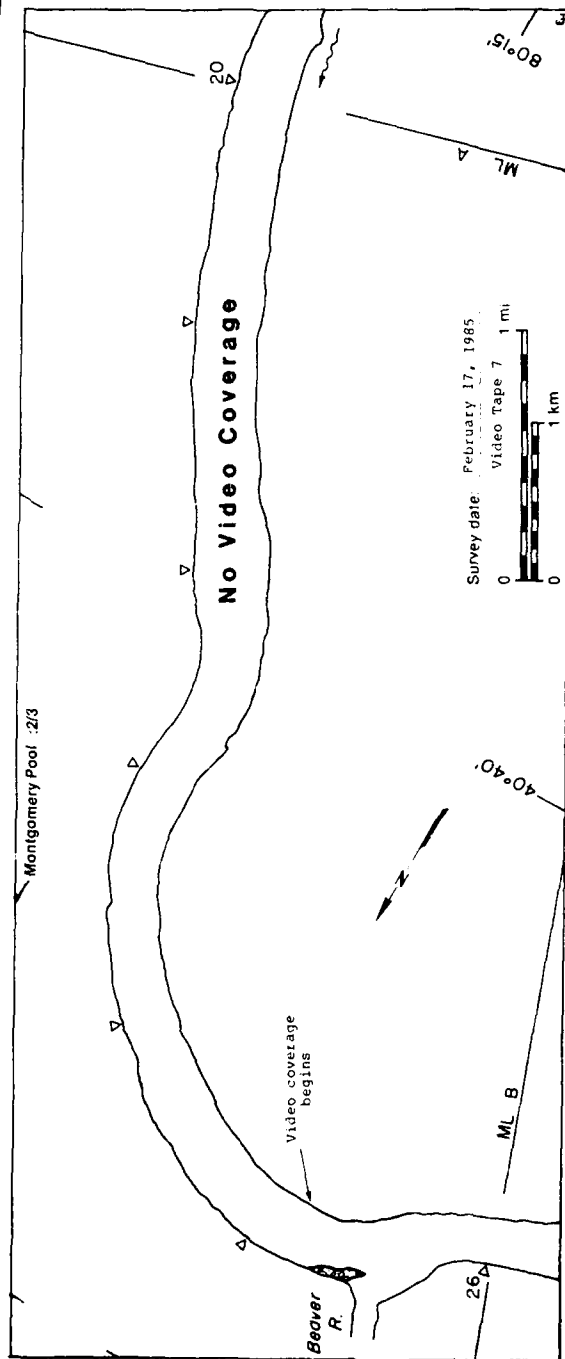
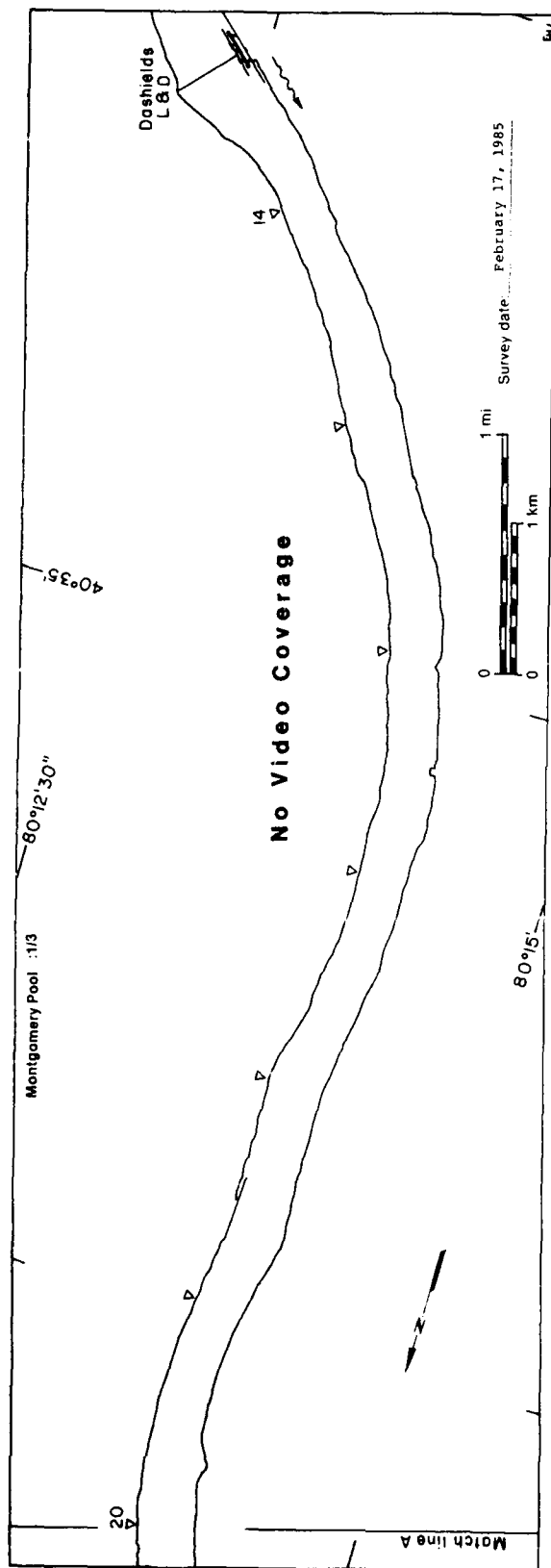
- Open water
- Solid ice cover
- Solid ice cover with open-water areas
- Fragmented ice cover
- Fragmented ice cover with open-water areas
- Ice floes or frazil slush and pans

Area (m² x 10⁶)

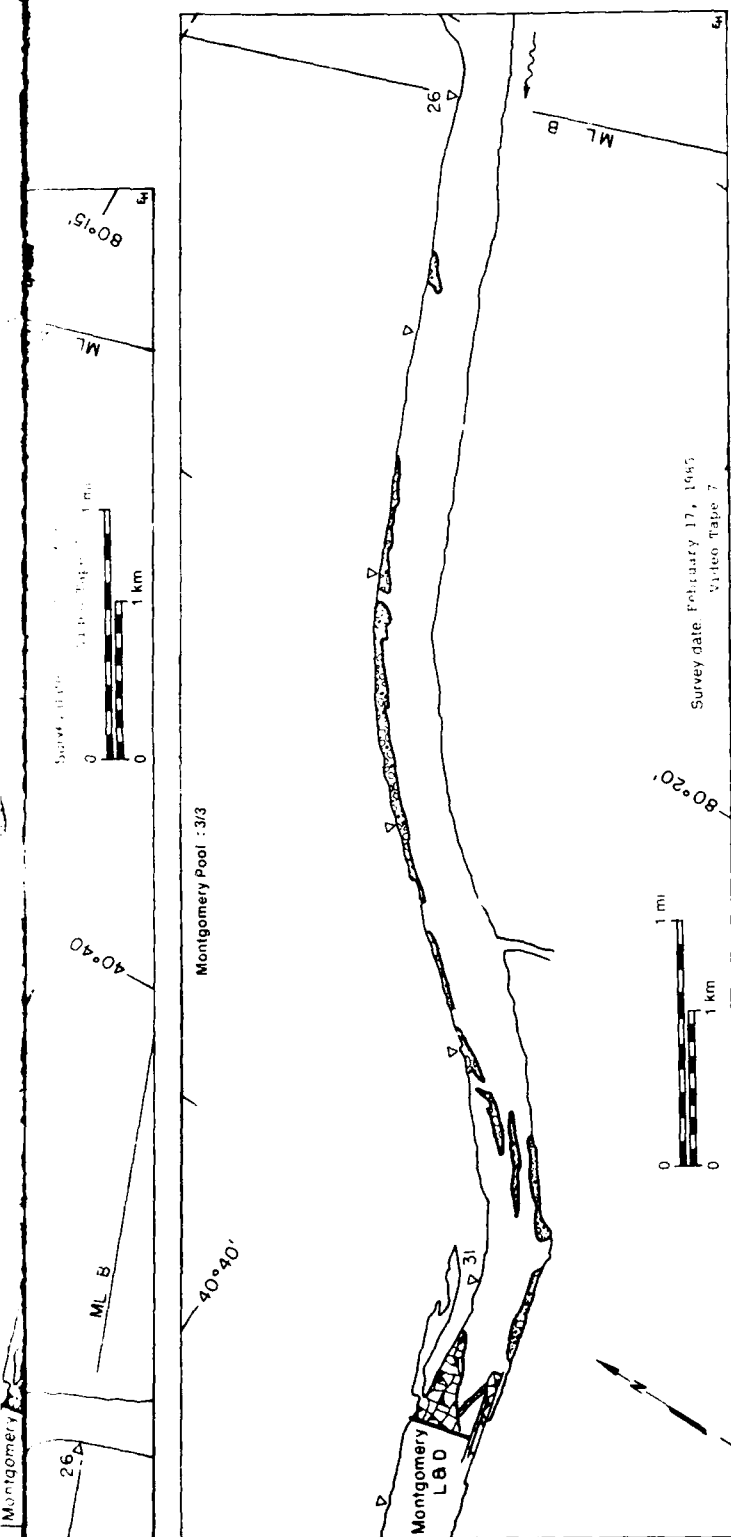
22.02	NA
--	NA
--	--
0.26	NA
4.65	50
0.35	5
27.28	

Total Area (m² x 10⁶)

17 February 1985

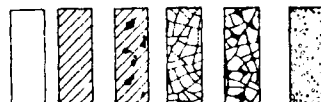


Montgomery Pool : 3/3



Montgomery Pool

MAP UNITS



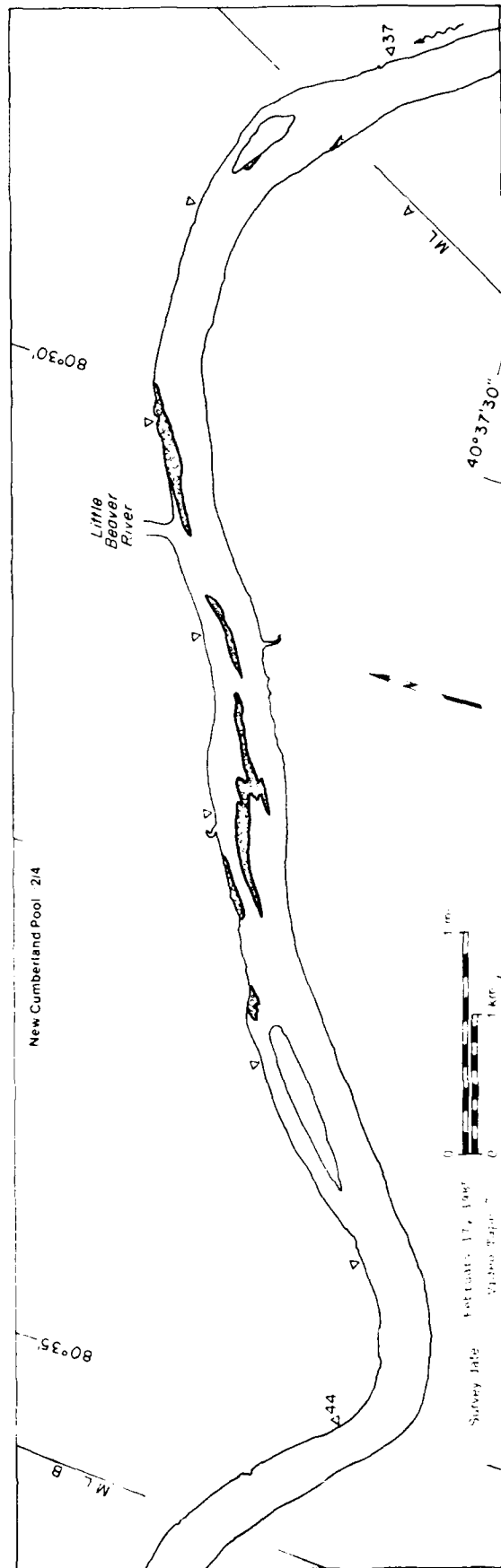
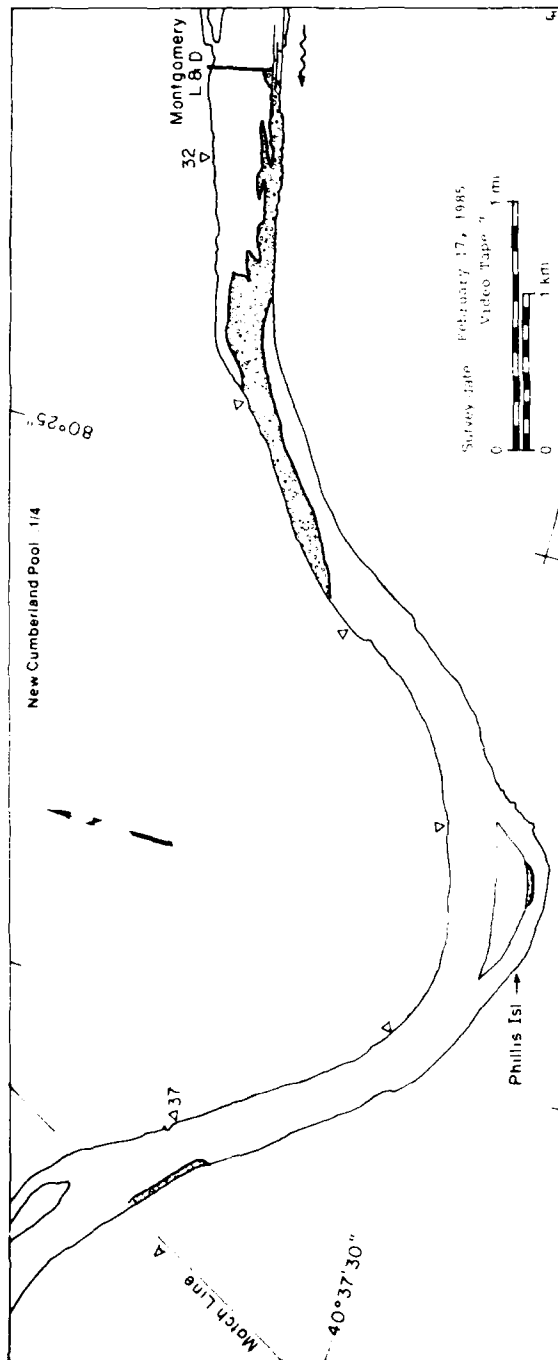
Area (m² x 10⁶)

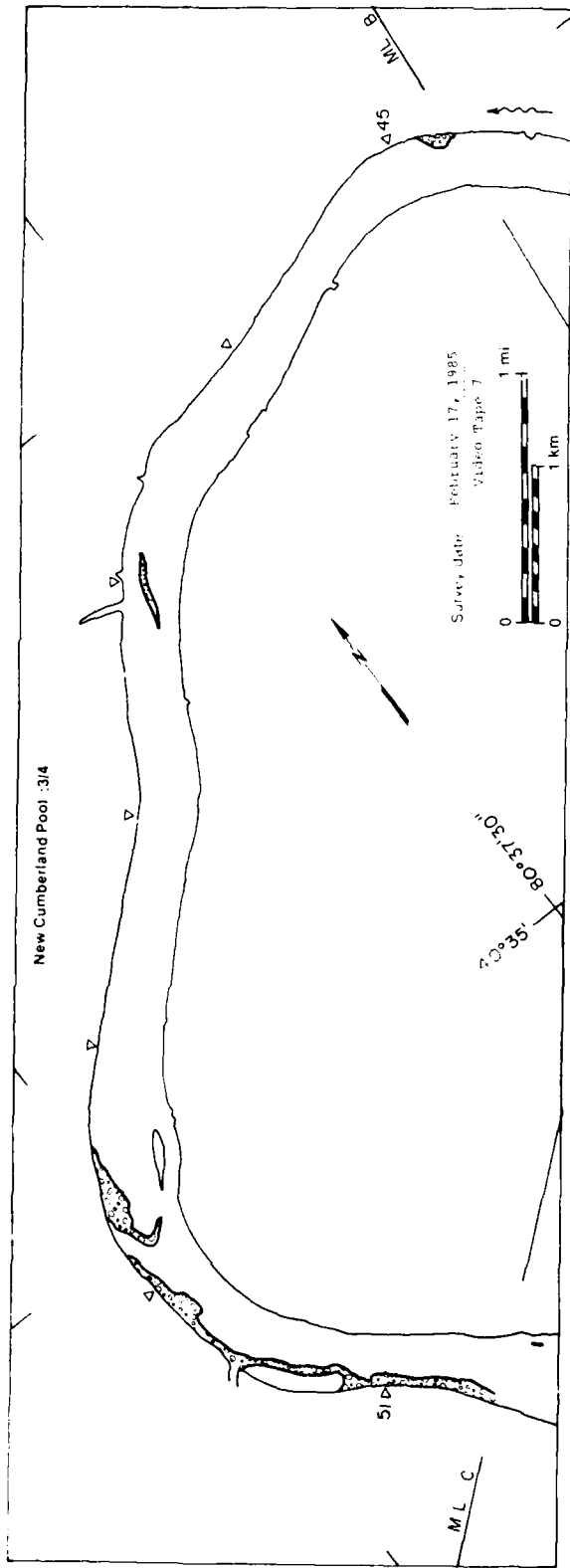
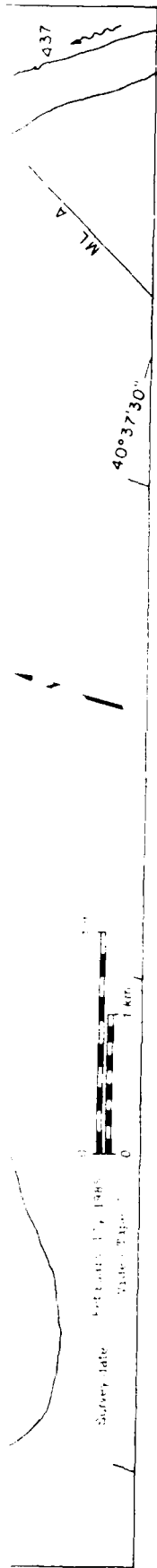
Area (m ² x 10 ⁶)	Surface concentration (%)
3.42	NA
—	NA
—	—
—	NA
0.28	90
0.39	10
11.27*	

Total Area (m² x 10⁶)

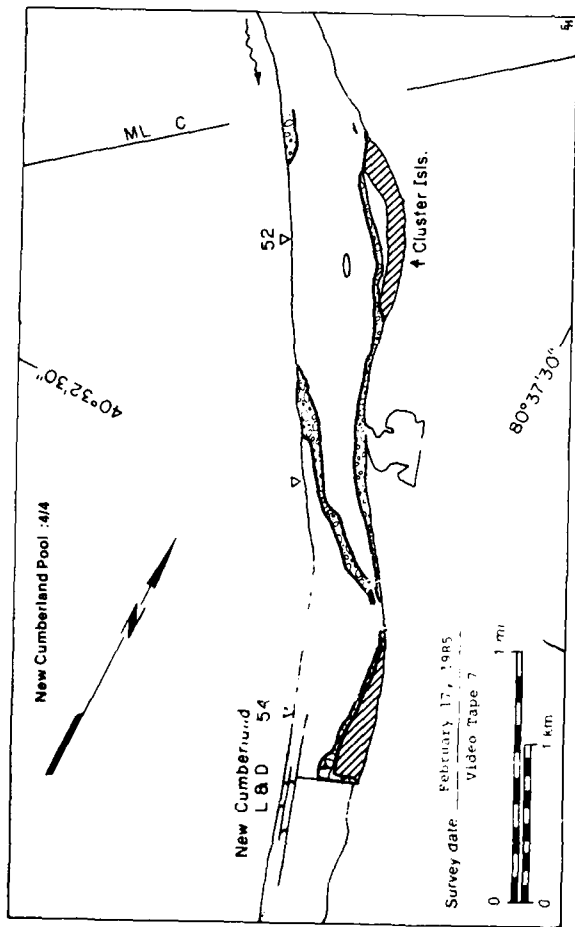
*includes 7.18 no video coverage

17 February 1985



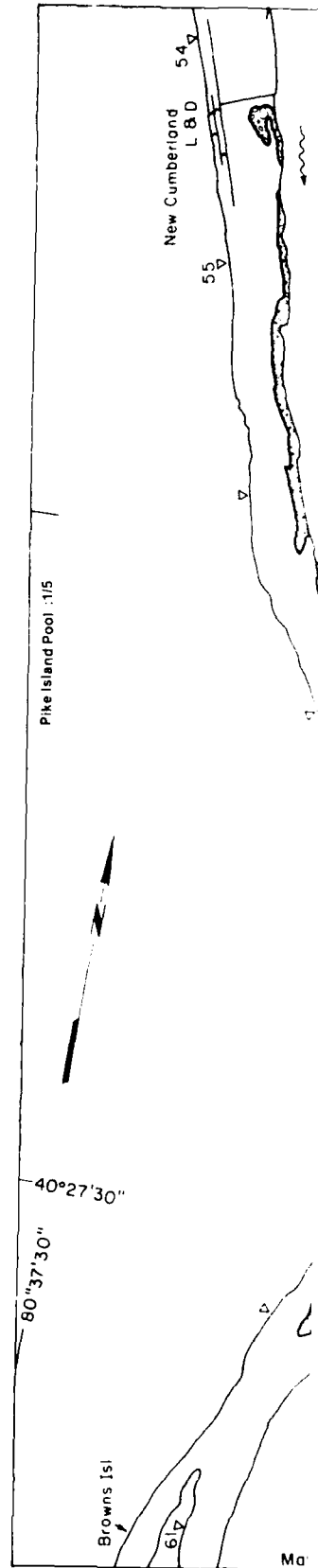


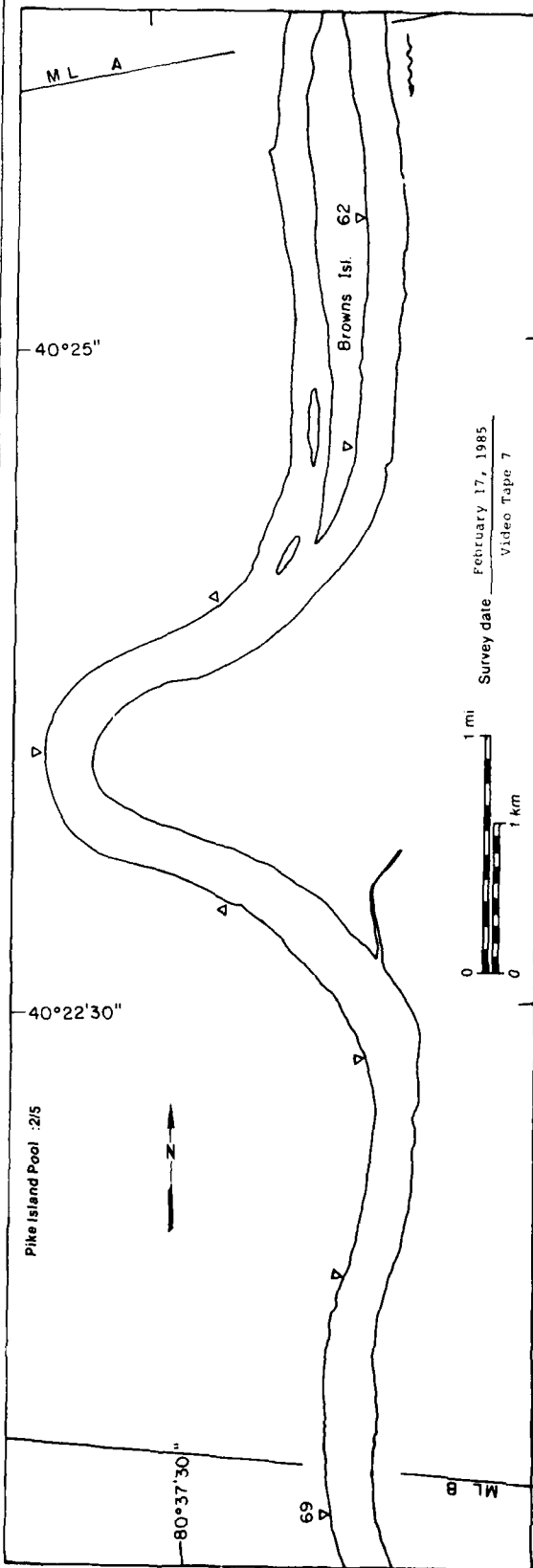
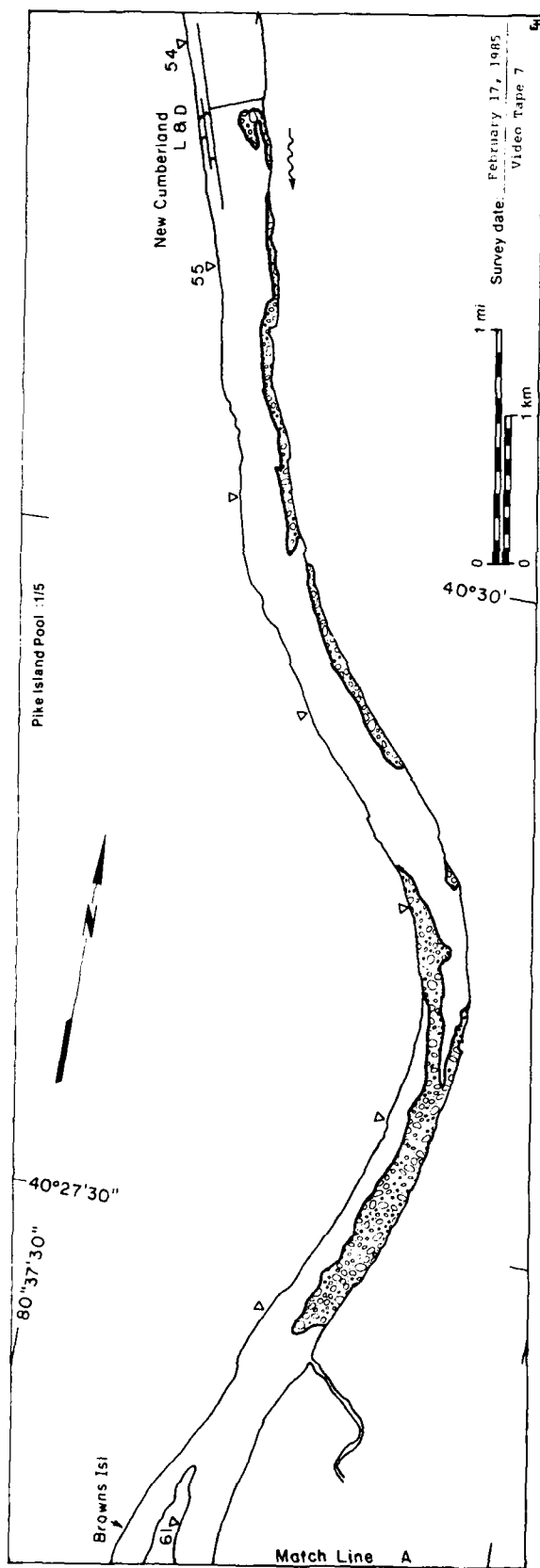
17 February 1985



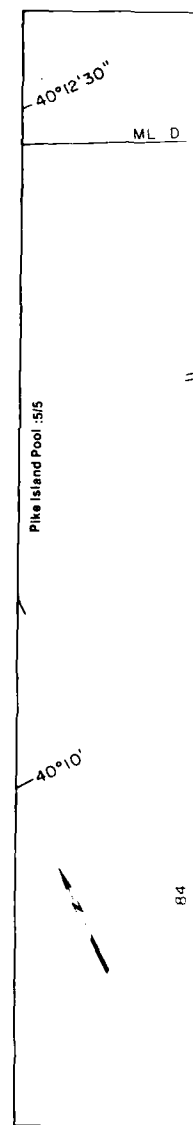
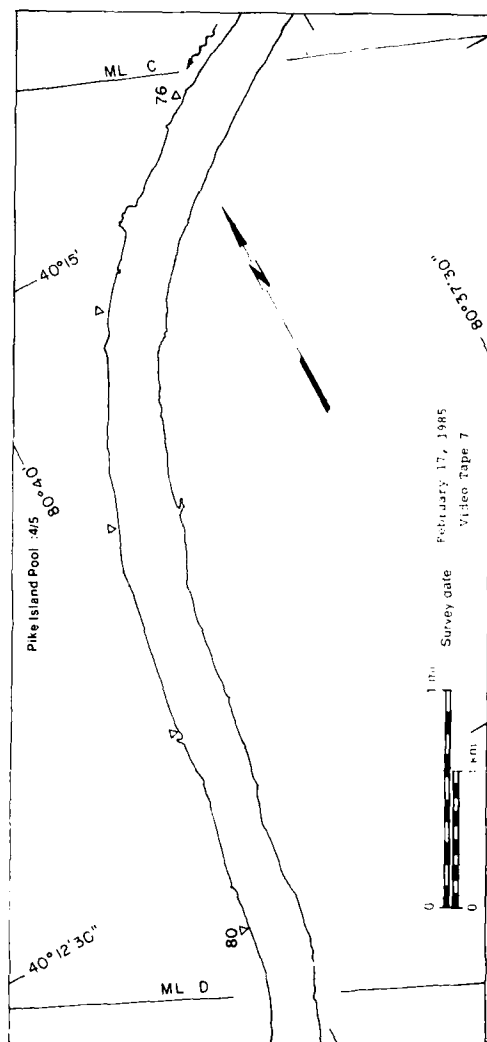
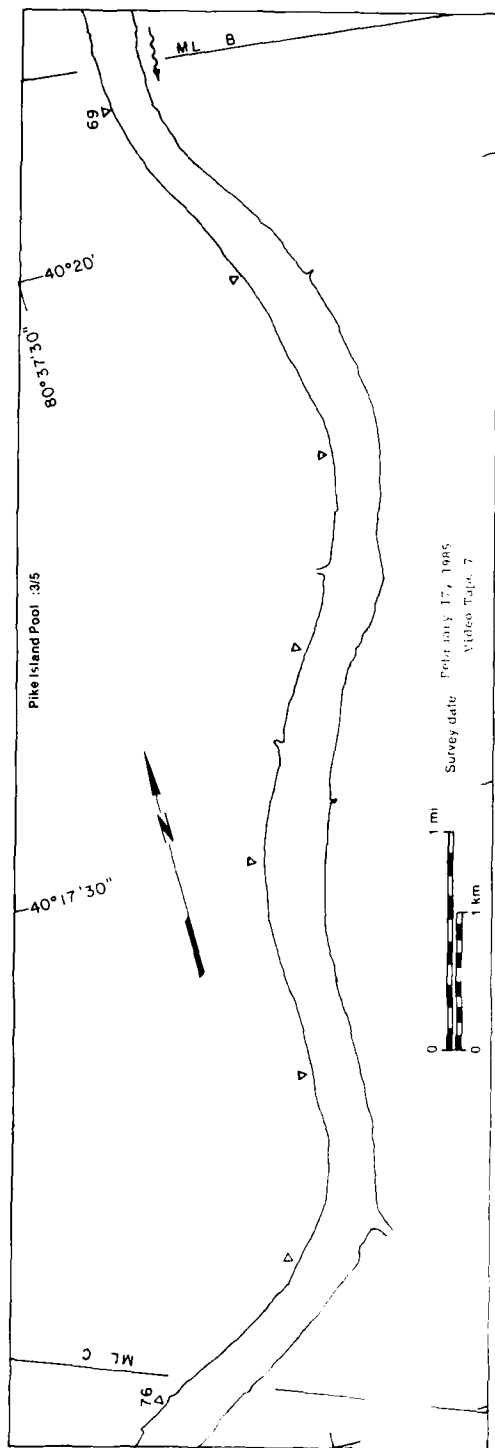
New Cumberland Pool

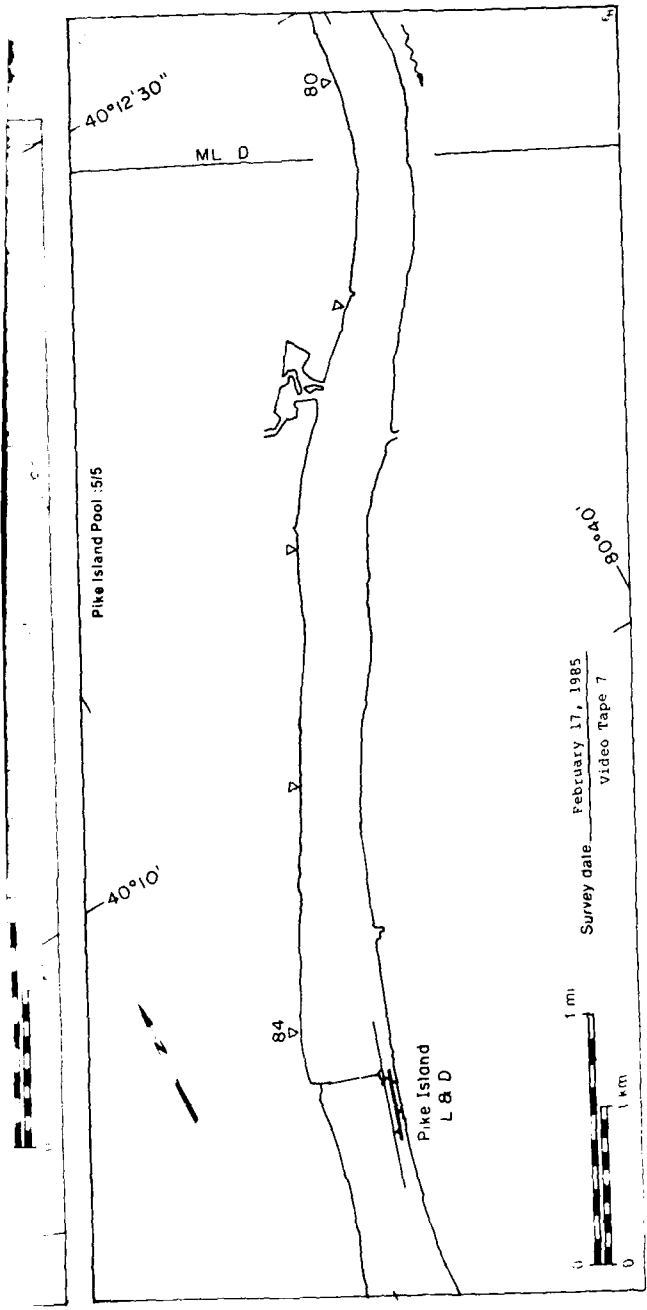
MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	13.19	NA
Solid ice cover	0.23	NA
Solid ice cover with open-water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	0.06	80
Ice floes or frazil slush and pans	1.39	5
Total Area (m ² x 10 ⁶)	14.87	





17 February 1985

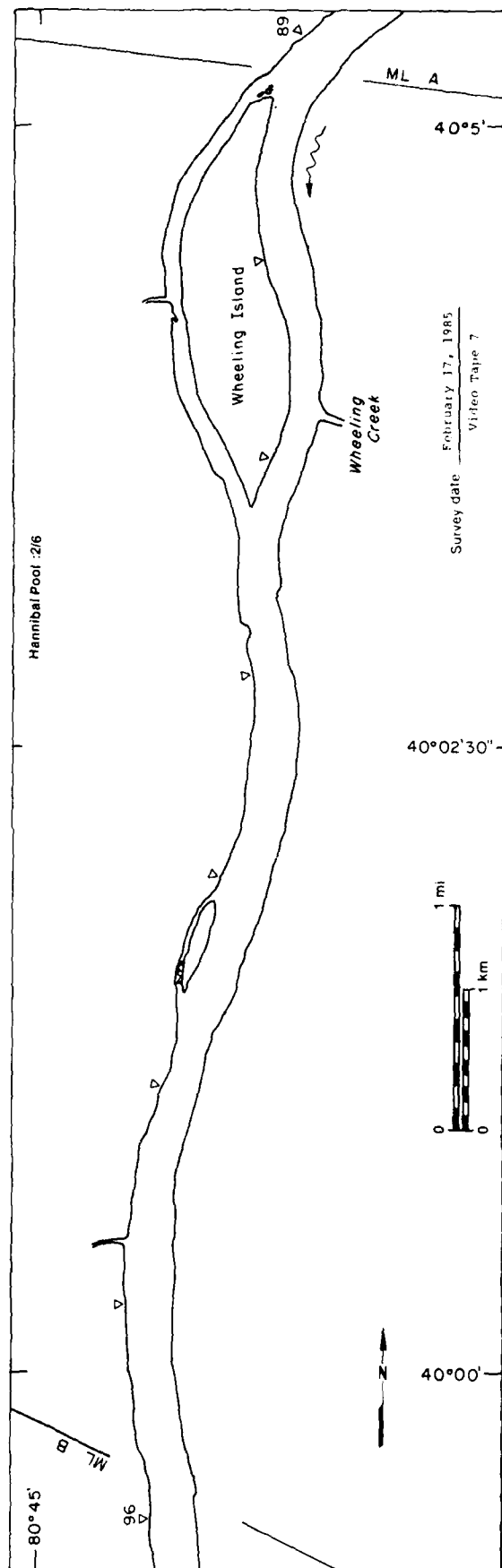
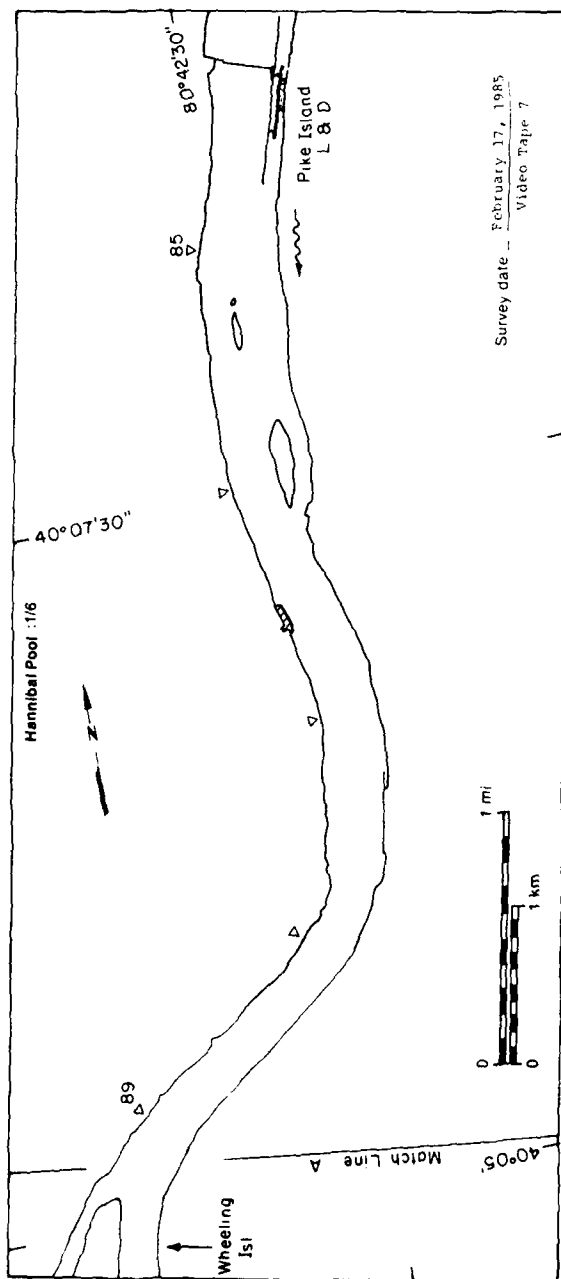




Pike Island Pool

MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	17.95	NA
Lead ice cover	---	NA
Lead ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	---	---
Ice piles of trail slush and bays	0.97	?
Total Area (m² x 10⁶)	18.92	

17 February 1985



Hannibal Pool :3/6

Wading
Creek

ML A

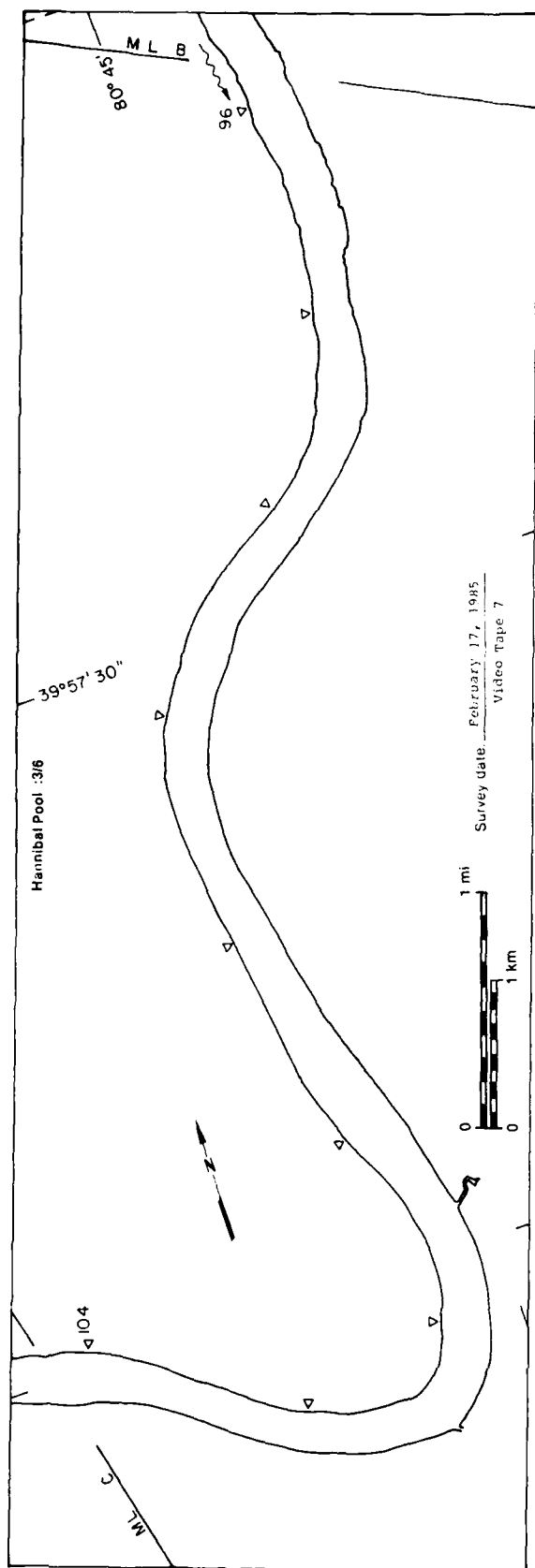
40°5'

Survey date February 17, 1985
Video Tape 7

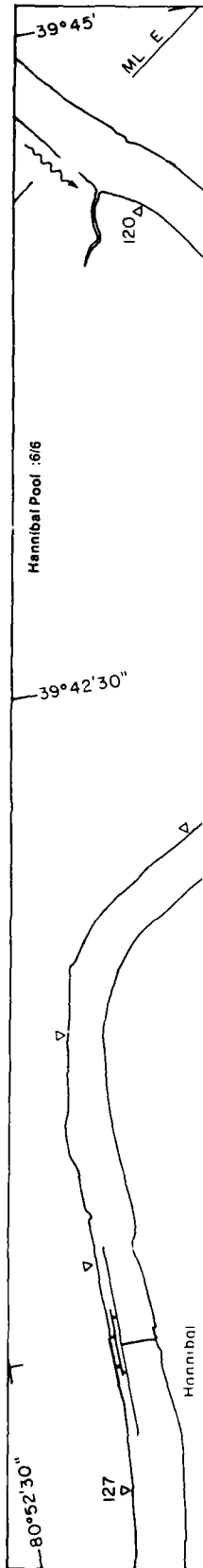
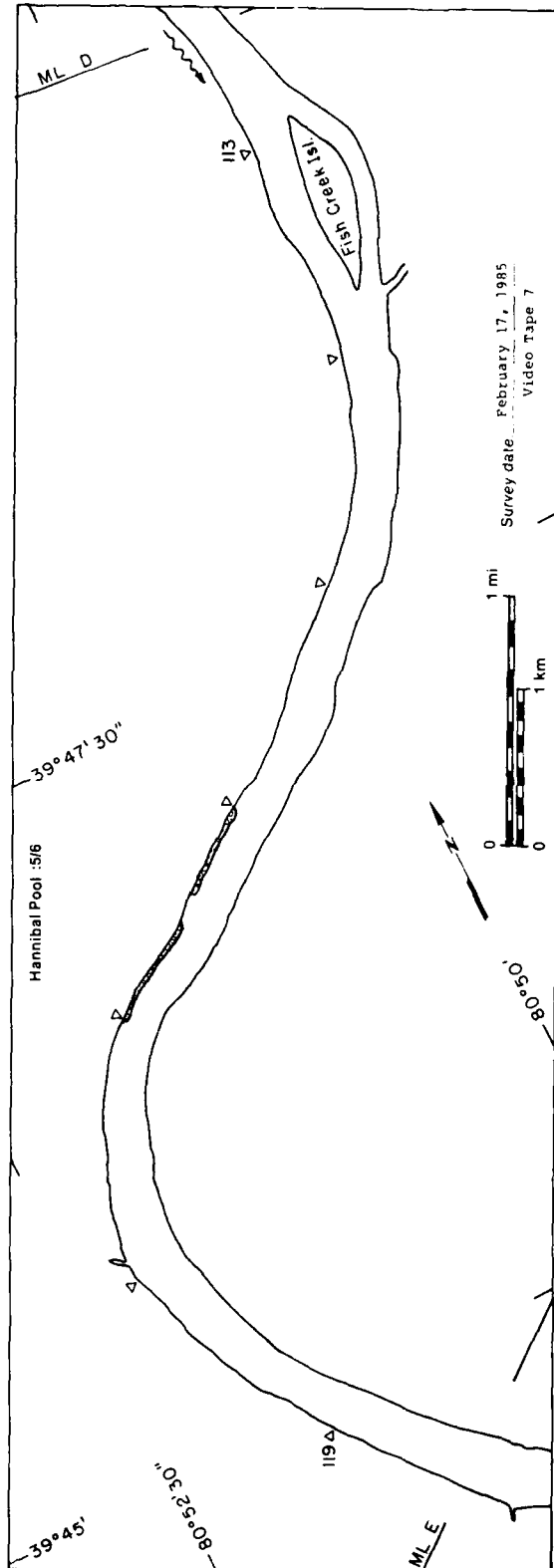
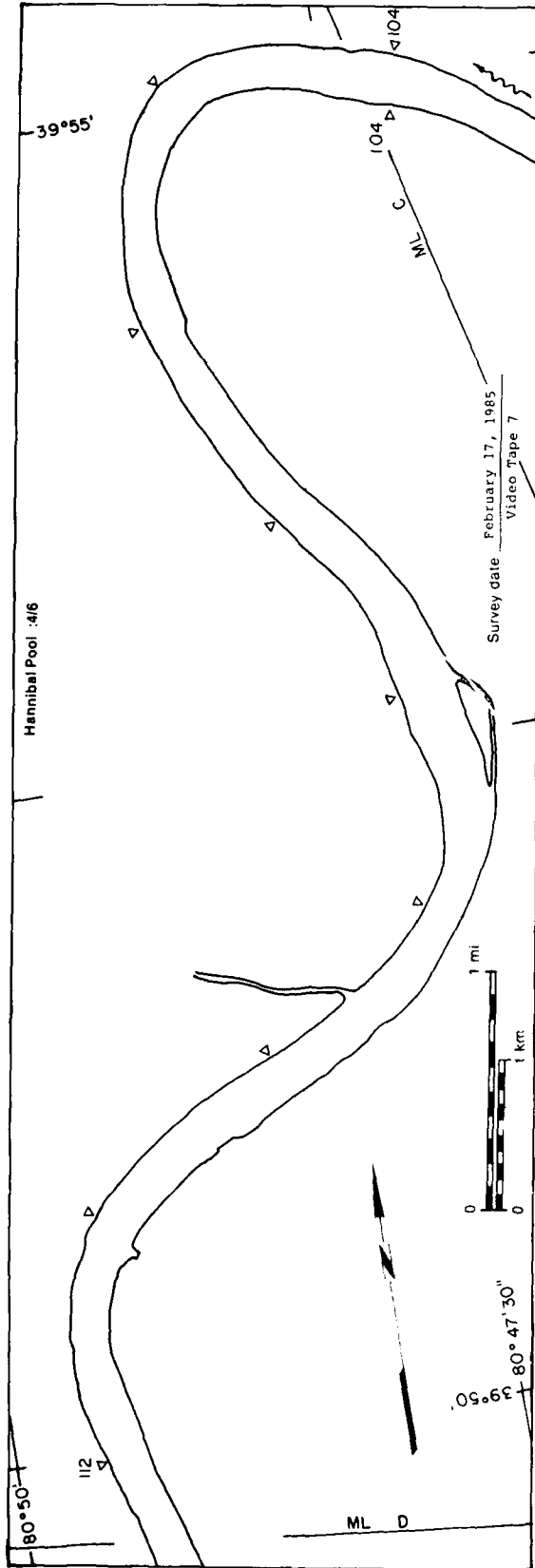
40°02'30"

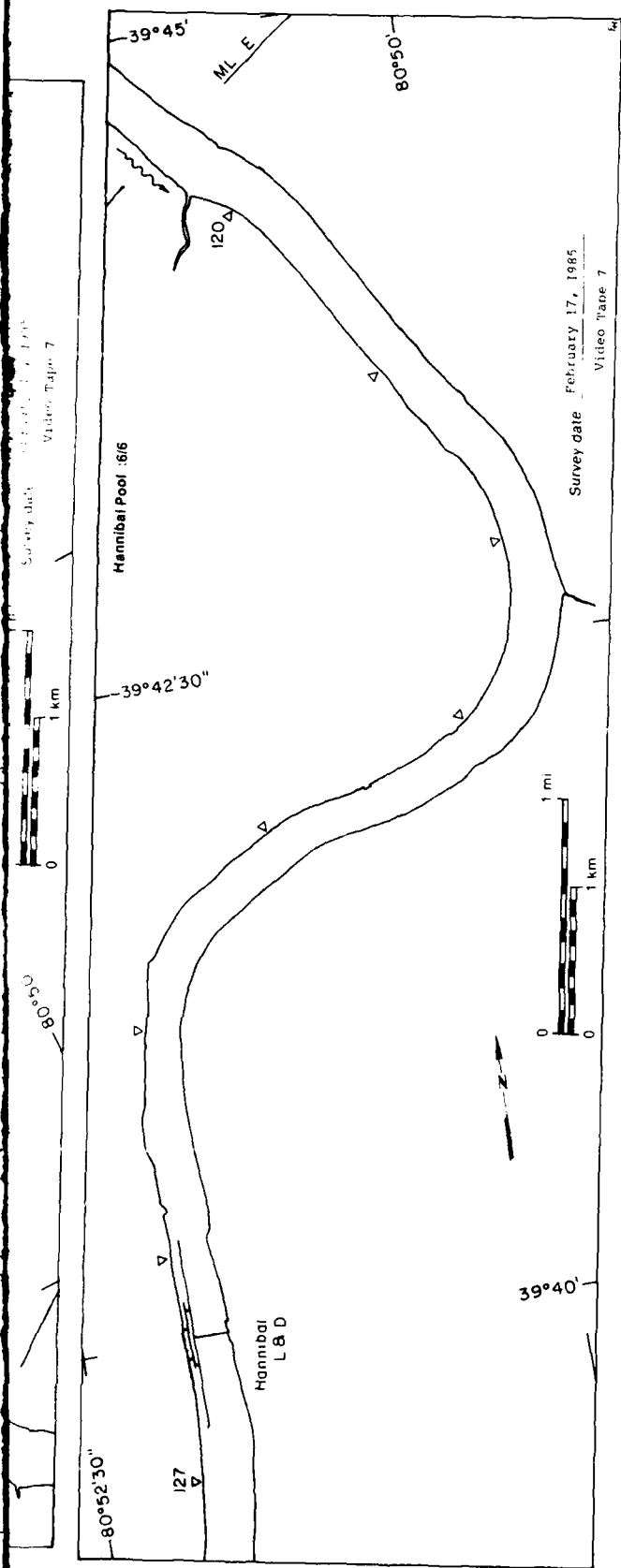


40°00'



17 February 1985

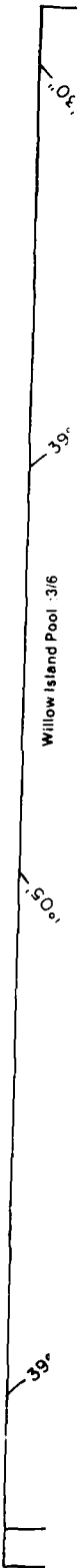
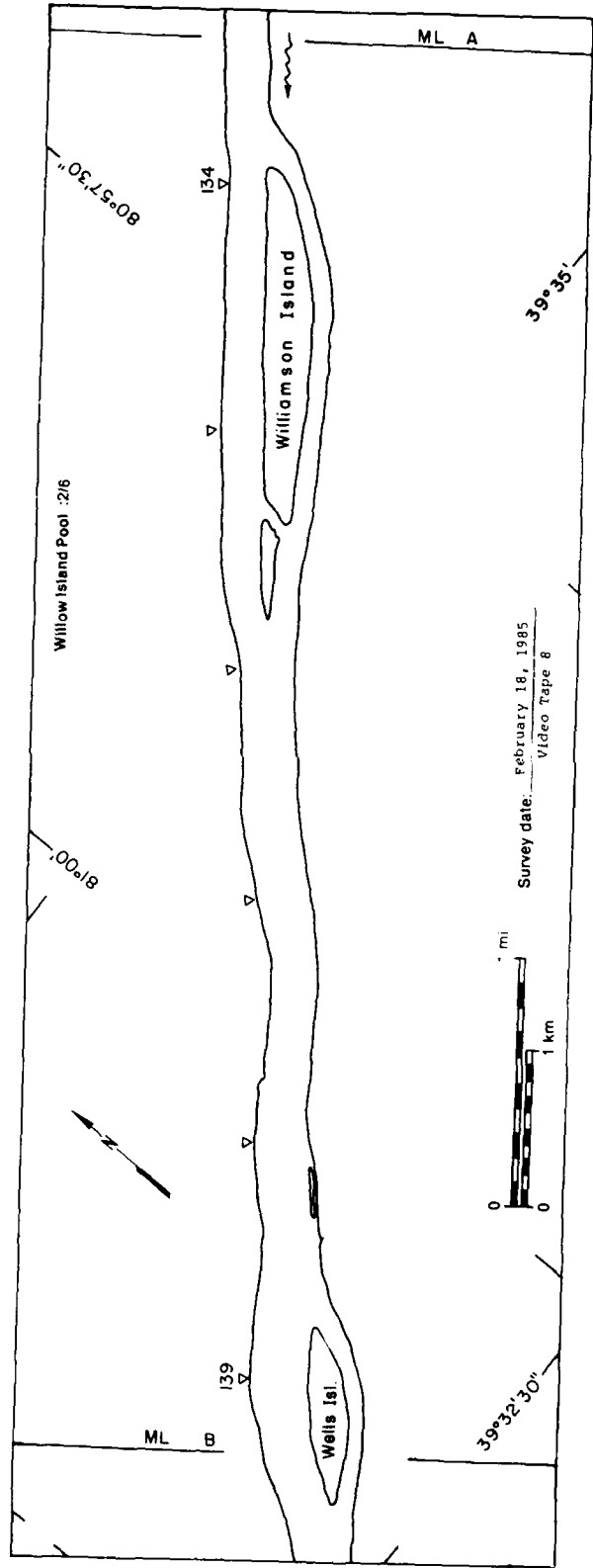
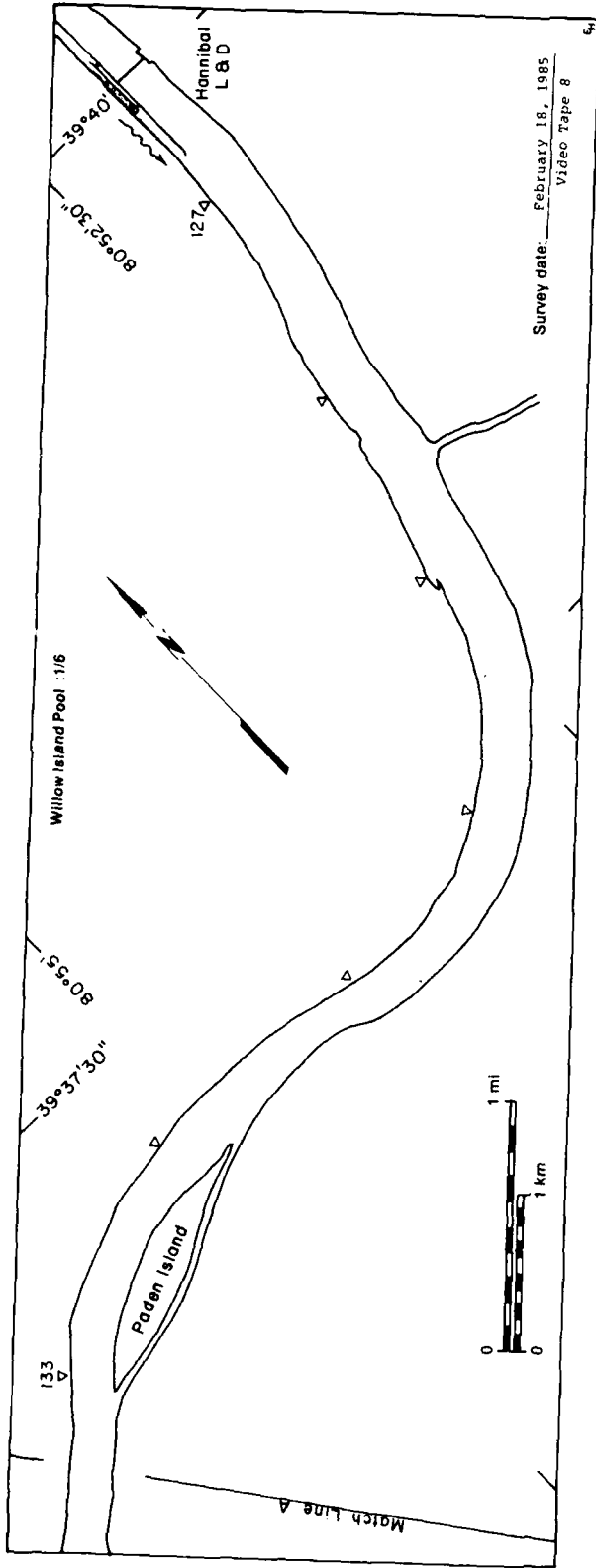


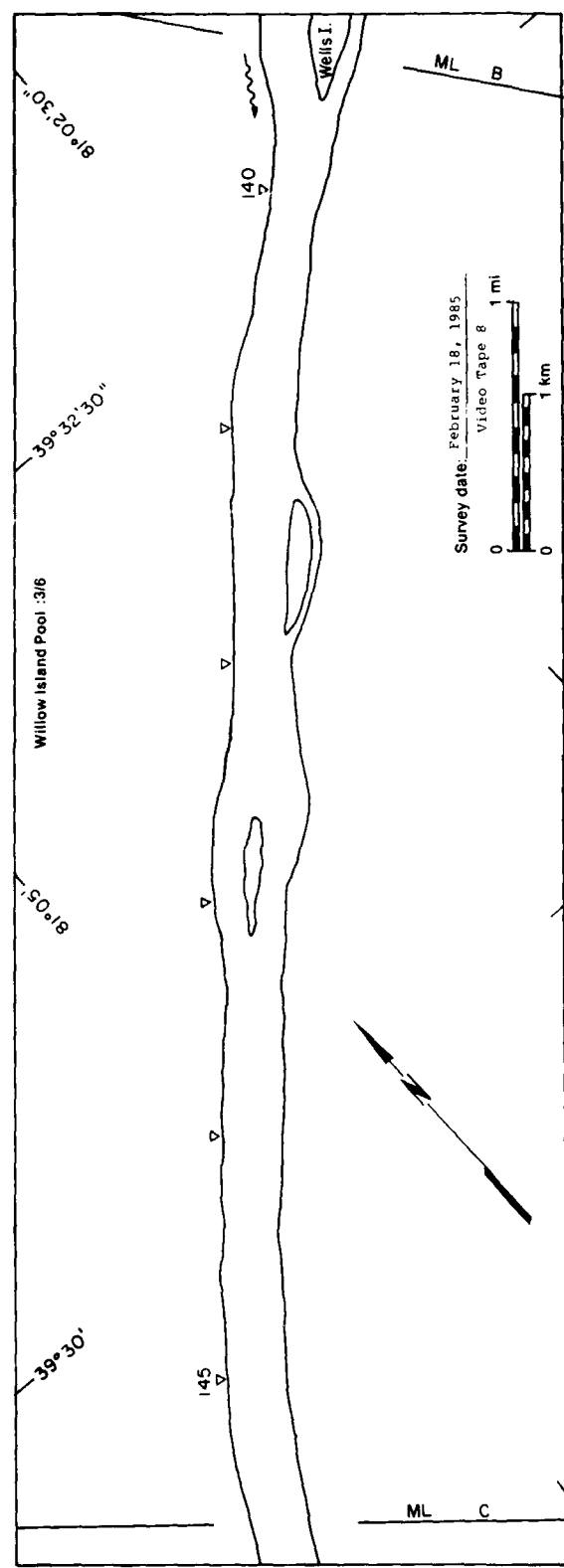
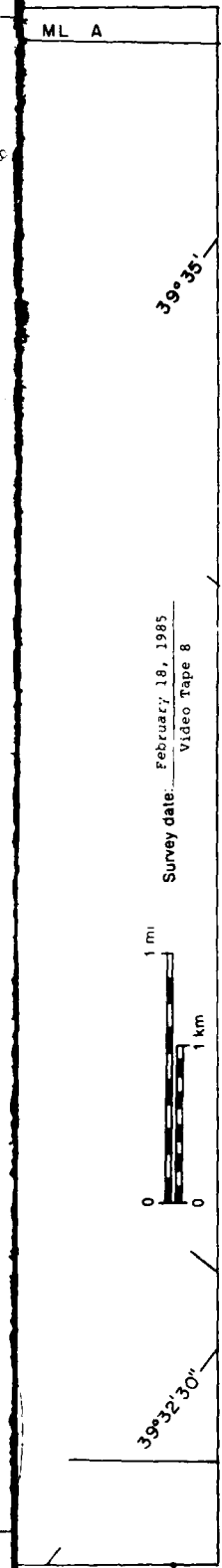


Hannibal Pool

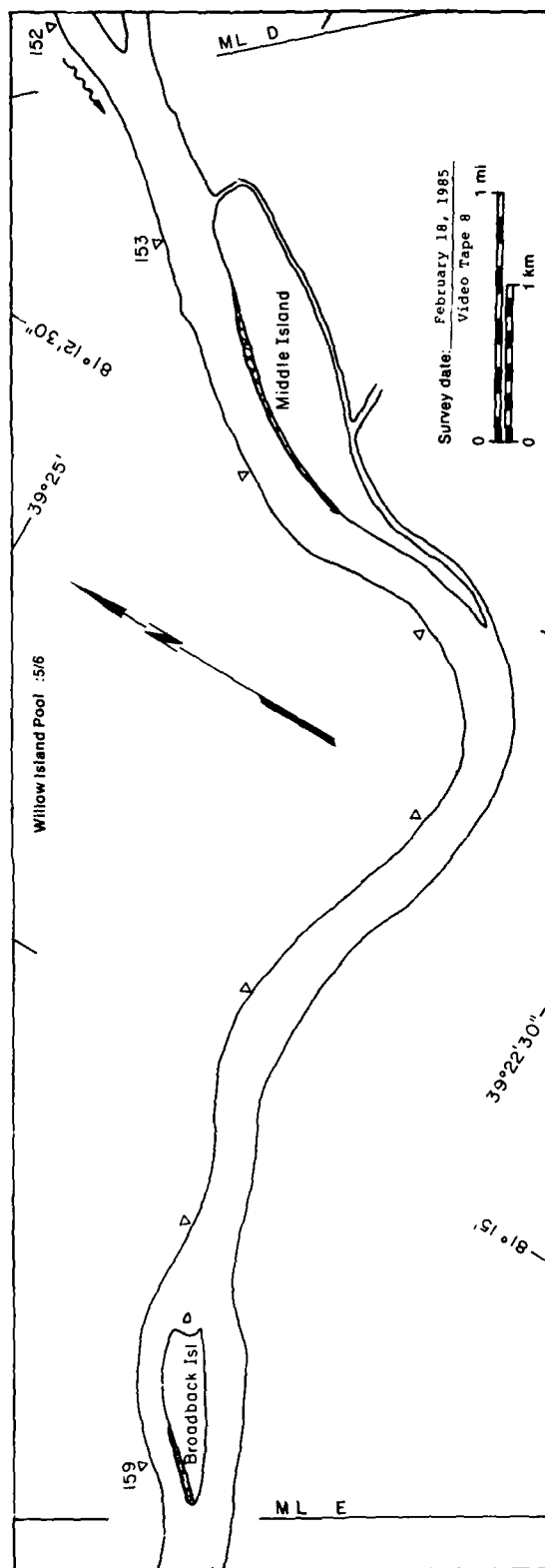
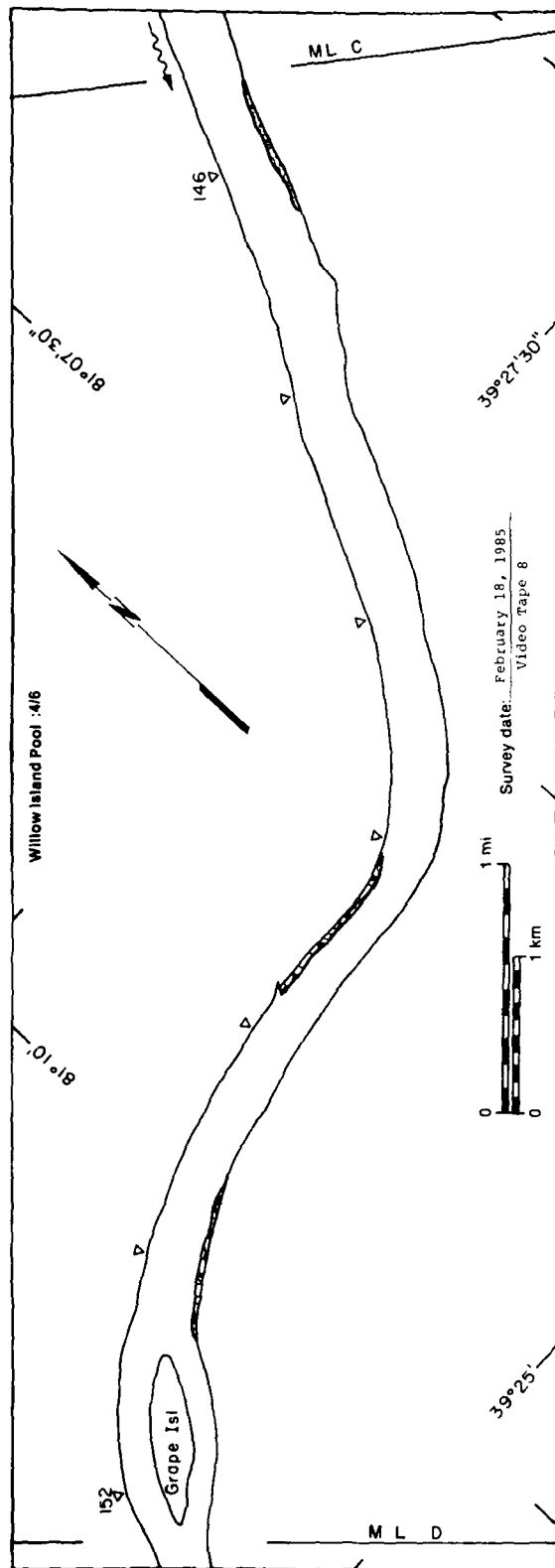
MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	22.33	NA
Solid ice cover	0.01	NA
Solid ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	0.01	9.0
Ice holes, ice edge slush and pans	0.06	2.0
Total Area (m ² x 10 ⁶)	22.46	

18 February 1985





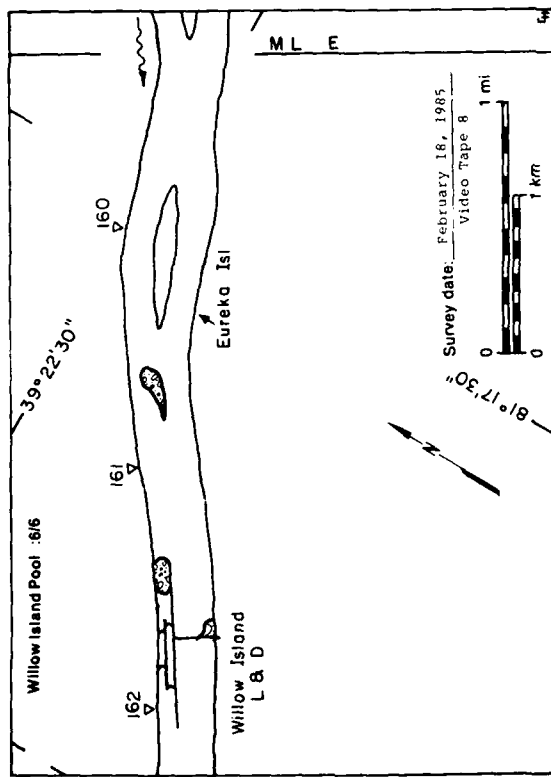
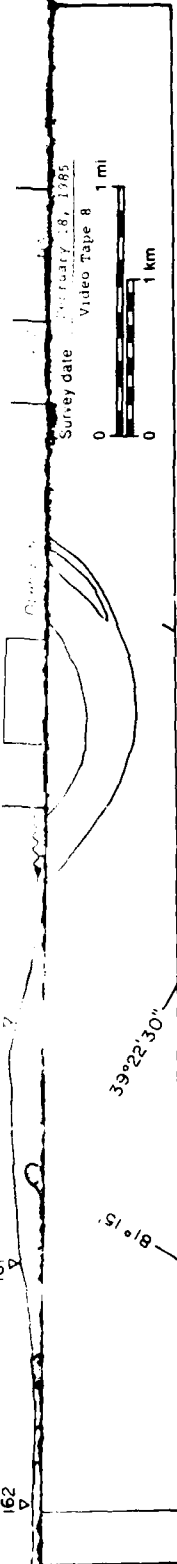
18 February 1985



Willow Island Pool :6/6

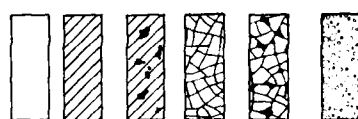
Willow Island Pool

Surface



Willow Island Pool

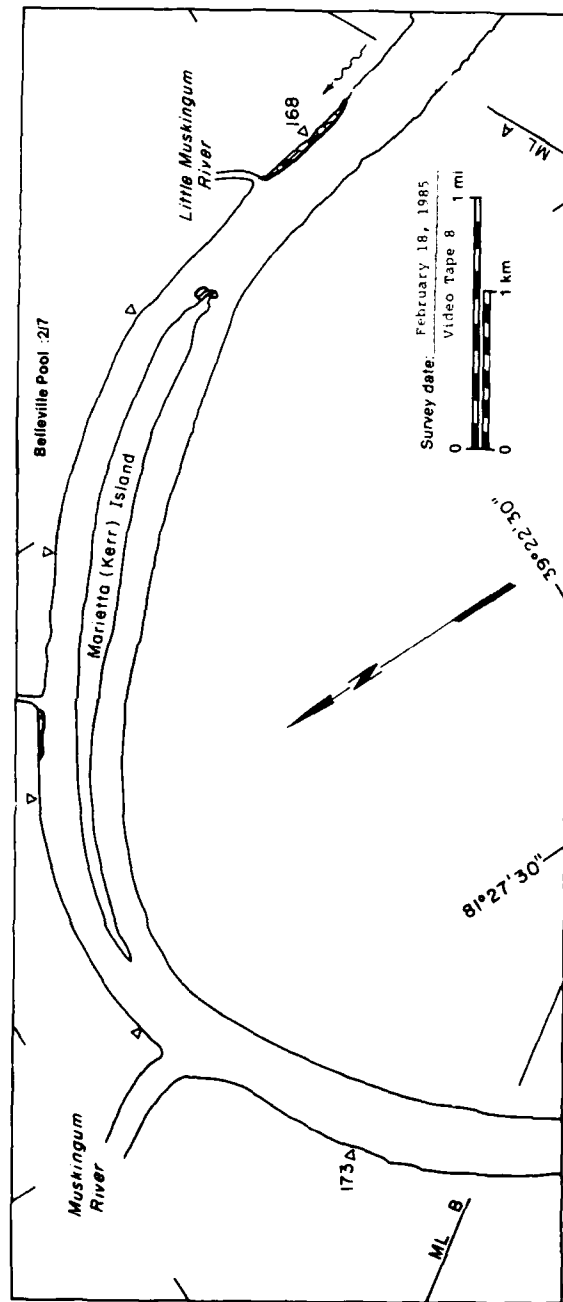
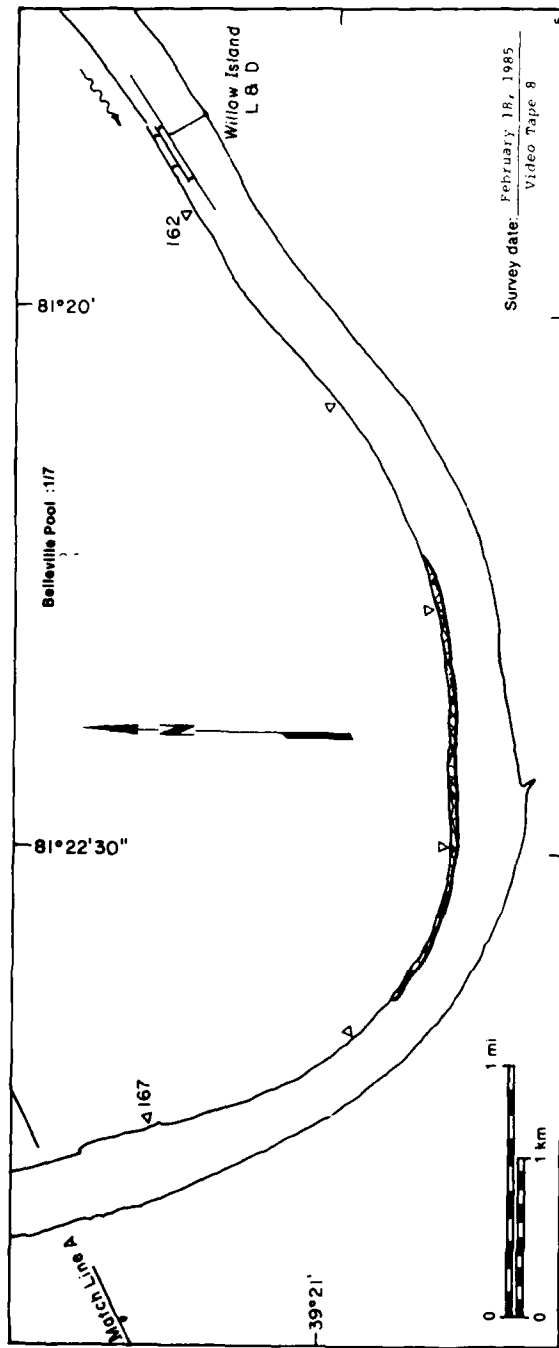
MAP UNITS

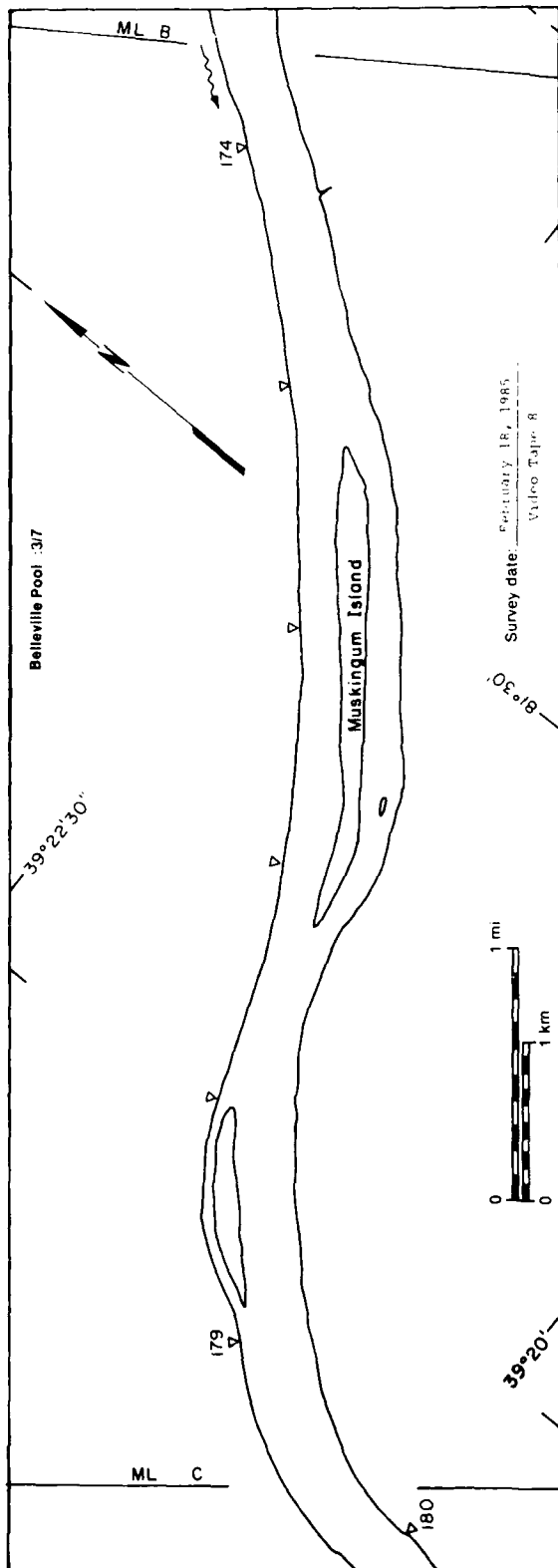
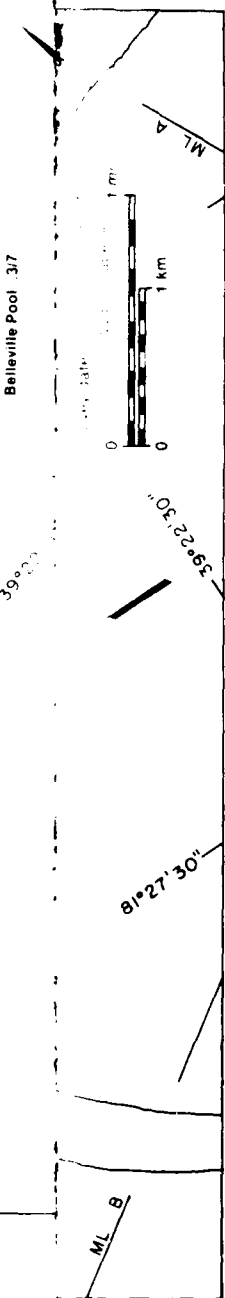


Area (m ² x 10 ⁶)	Surface concentration (%)
20.82	NA
--	NA
--	--
--	NA
0.18	90
0.24	1
21.24	

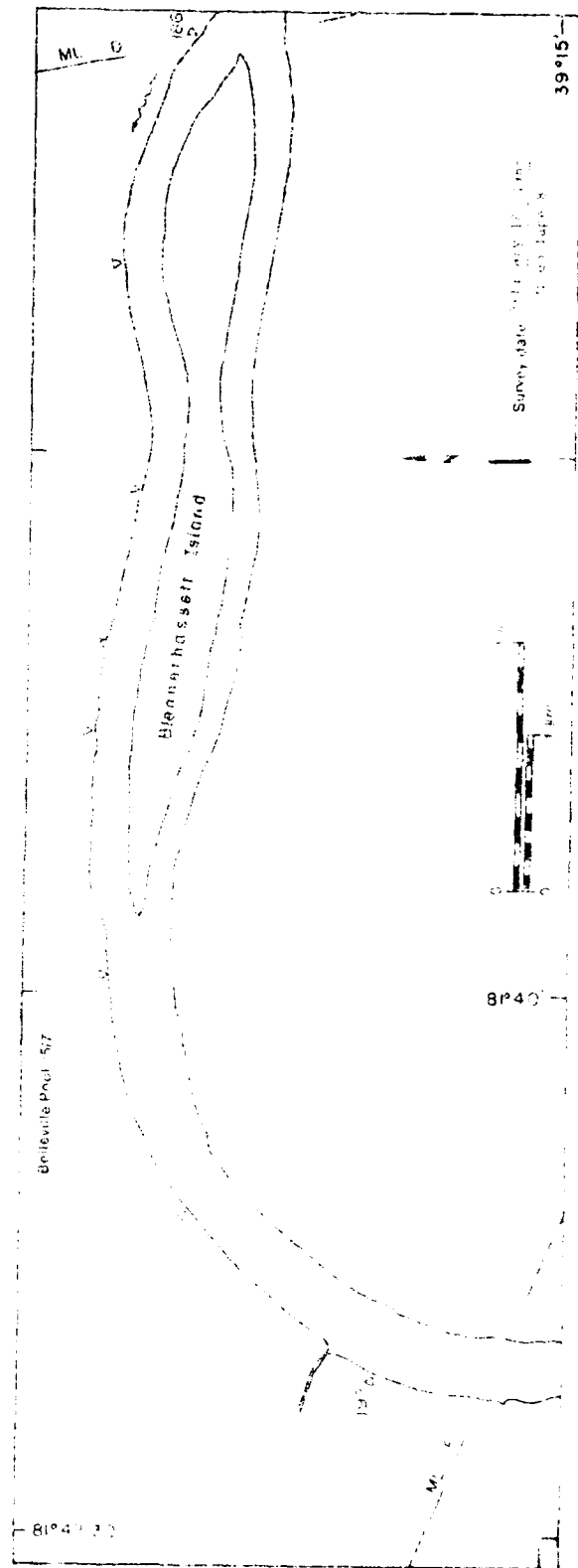
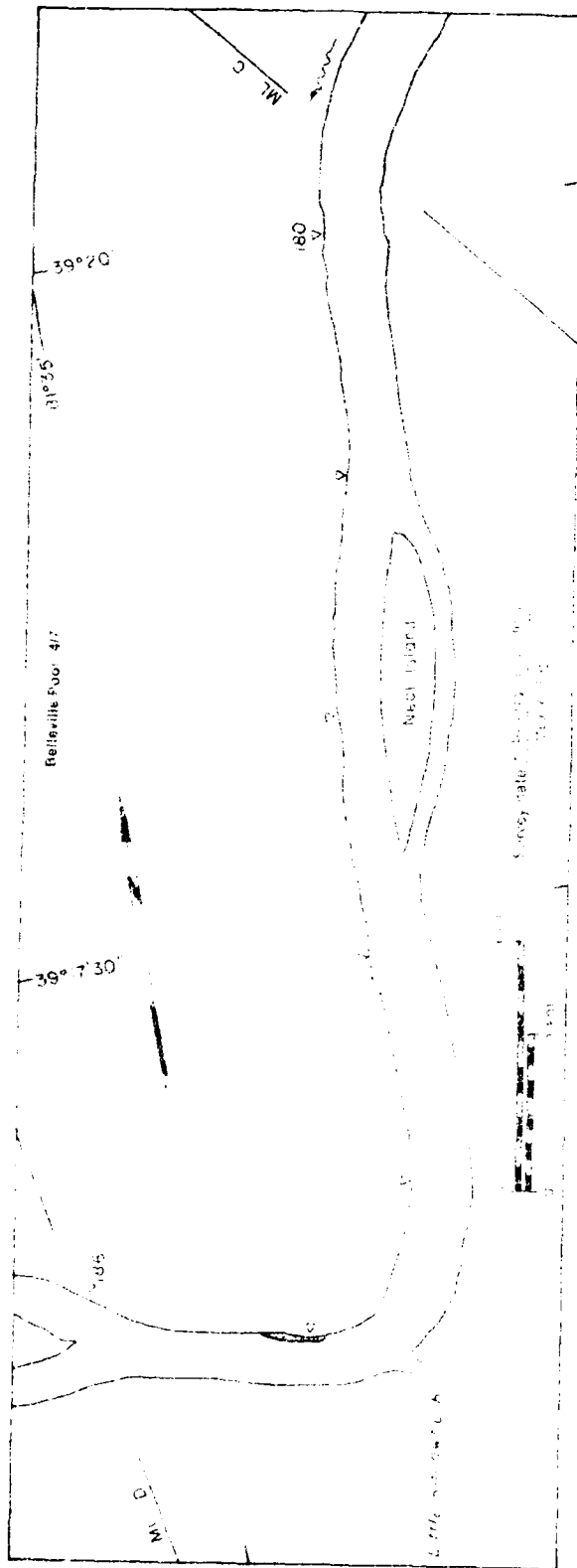
Total Area (m² x 10⁶)

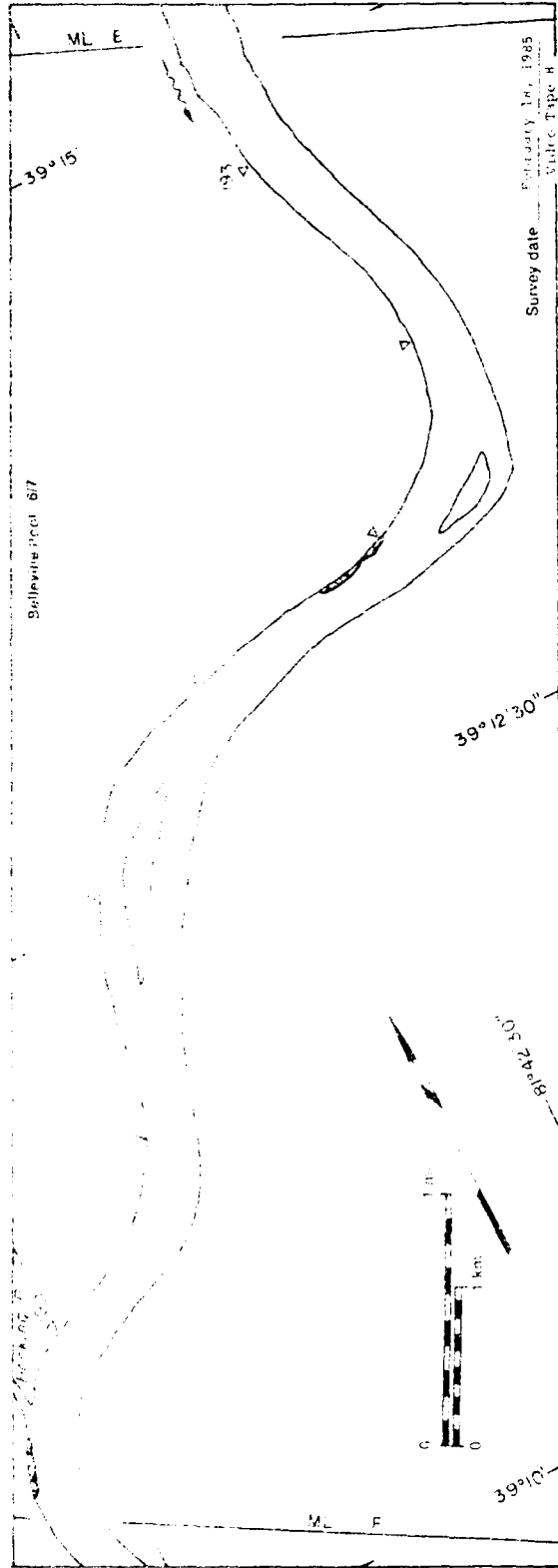
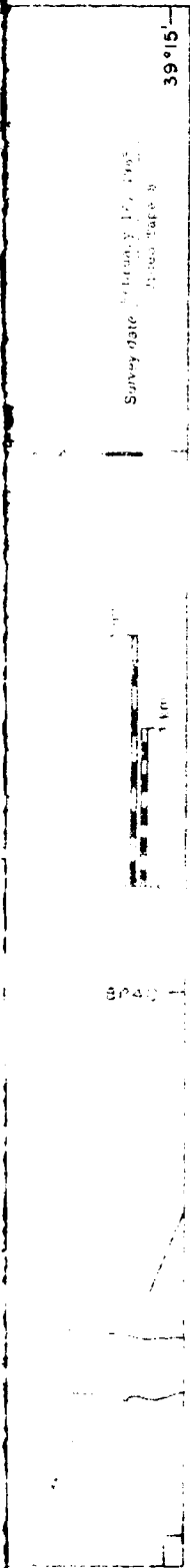
18 February 1985



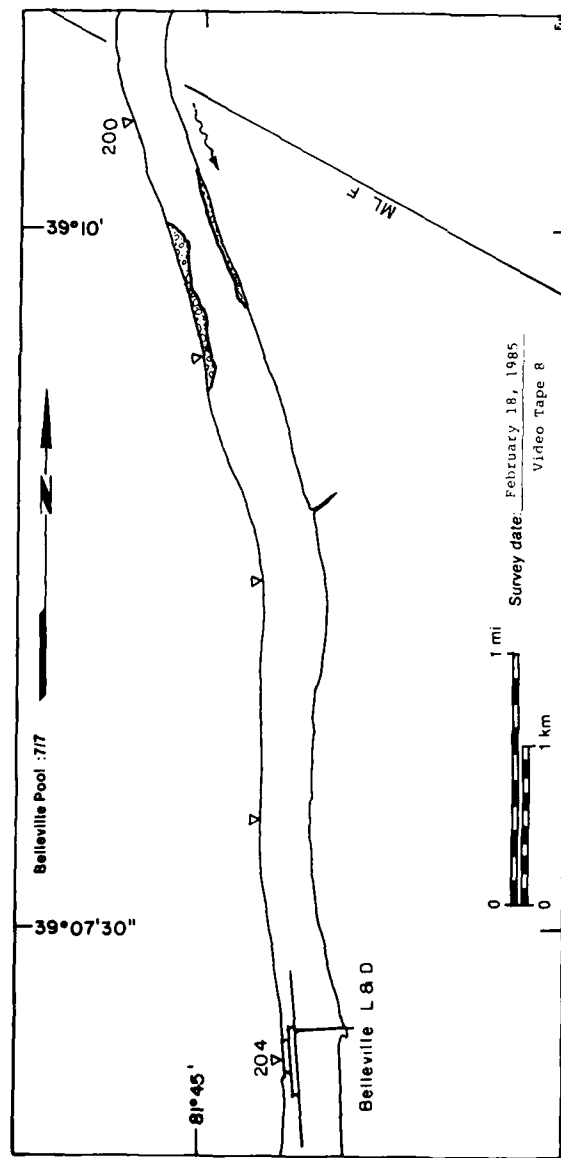


18 February 1985





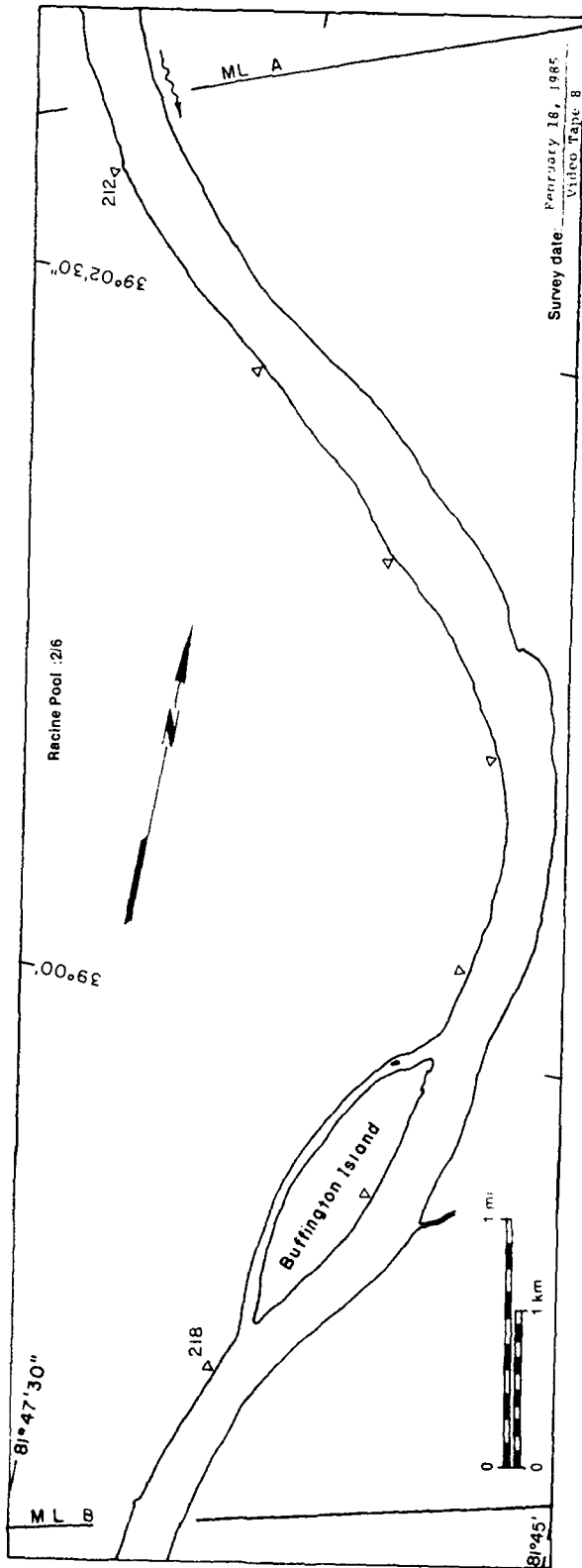
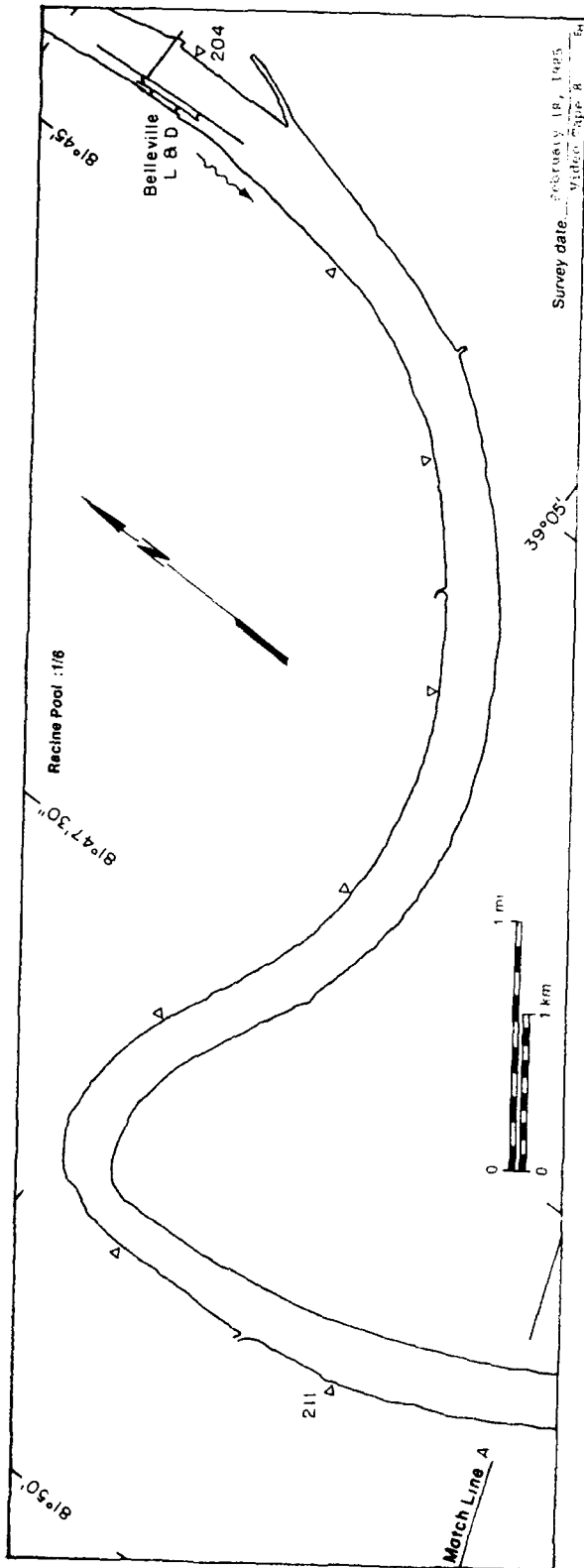
18 February 1985

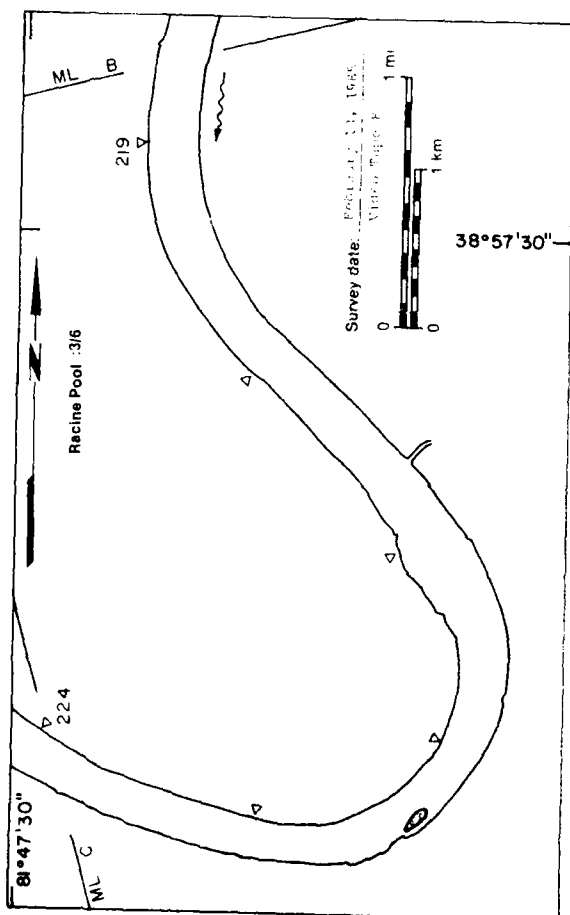
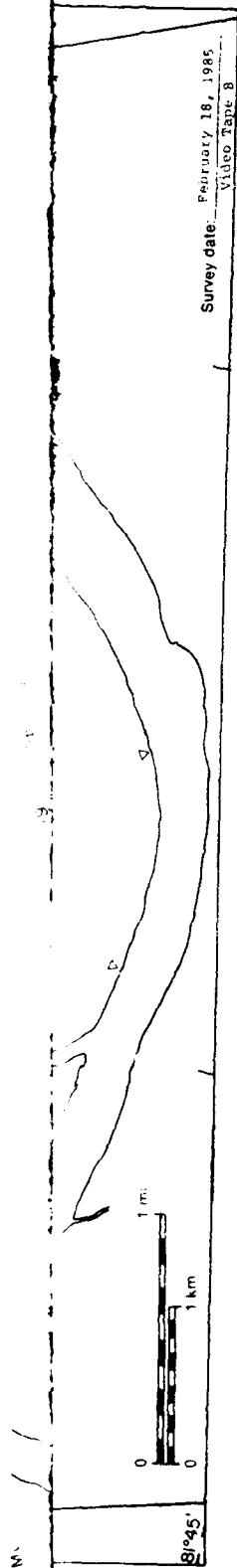


Belleville Pool

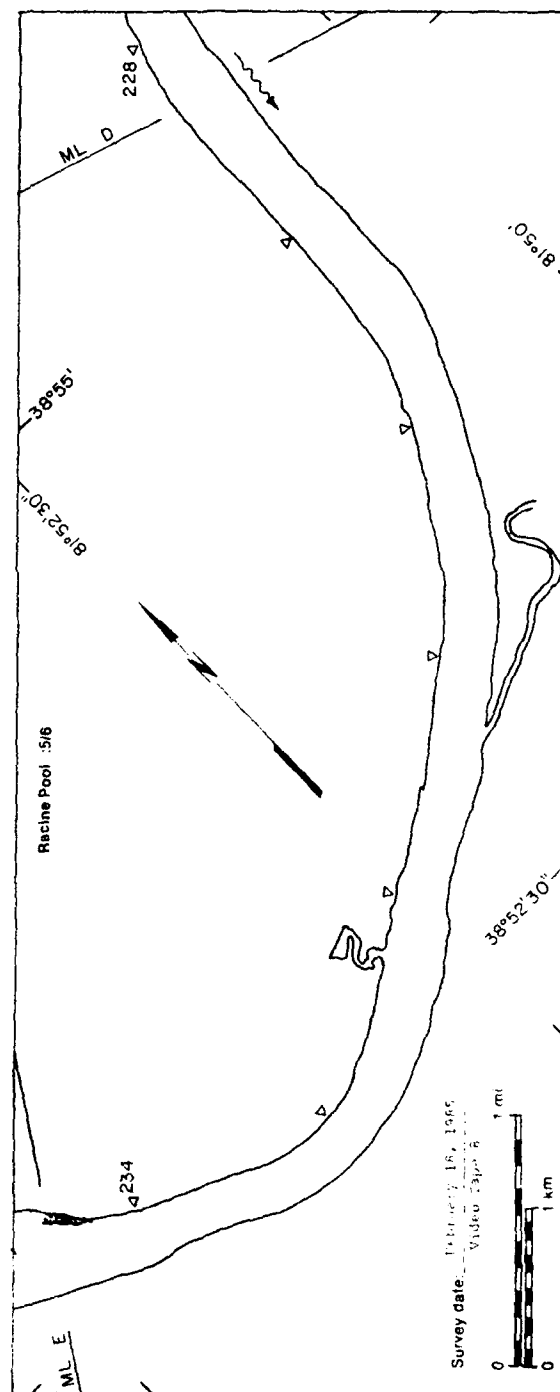
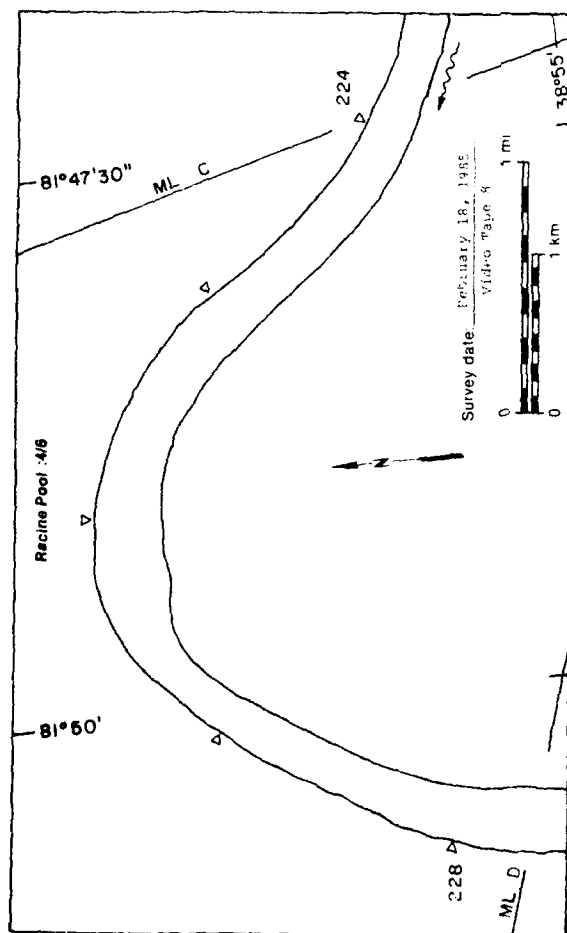
MAP UNITS		Surface concentration (%)
	Open water	26.76
	Solid ice cover	0.02
	Solid ice cover with open-water areas	0.15
	Fragmented ice cover	0.15
	Fragmented ice cover with open-water areas	80
	Ice floes or frazil slush and pans	2
Total Area (m ² x 10 ⁶)		27.28

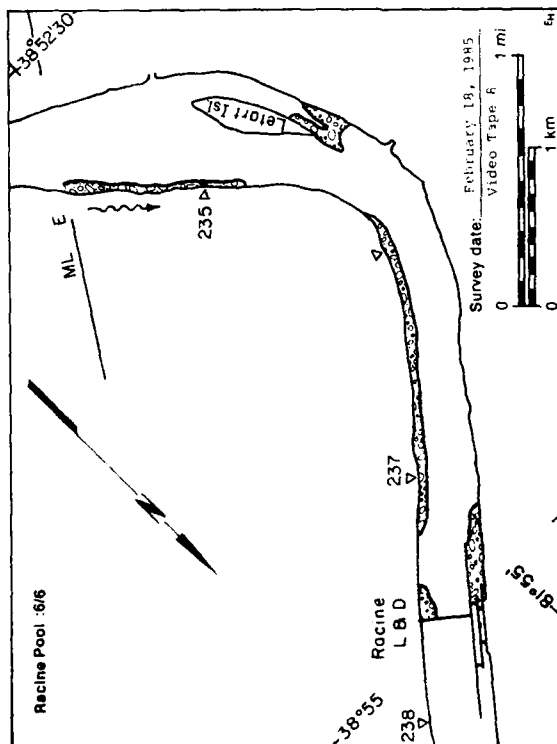
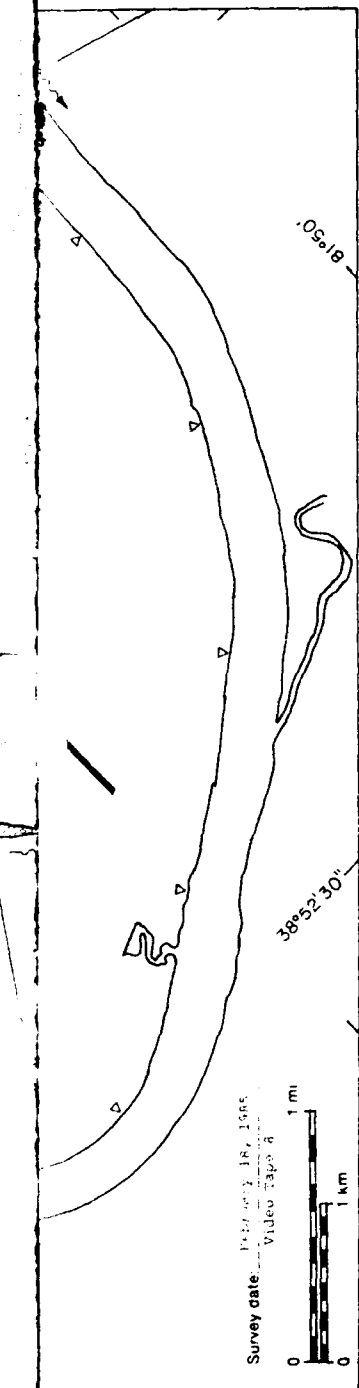
18 February 1985





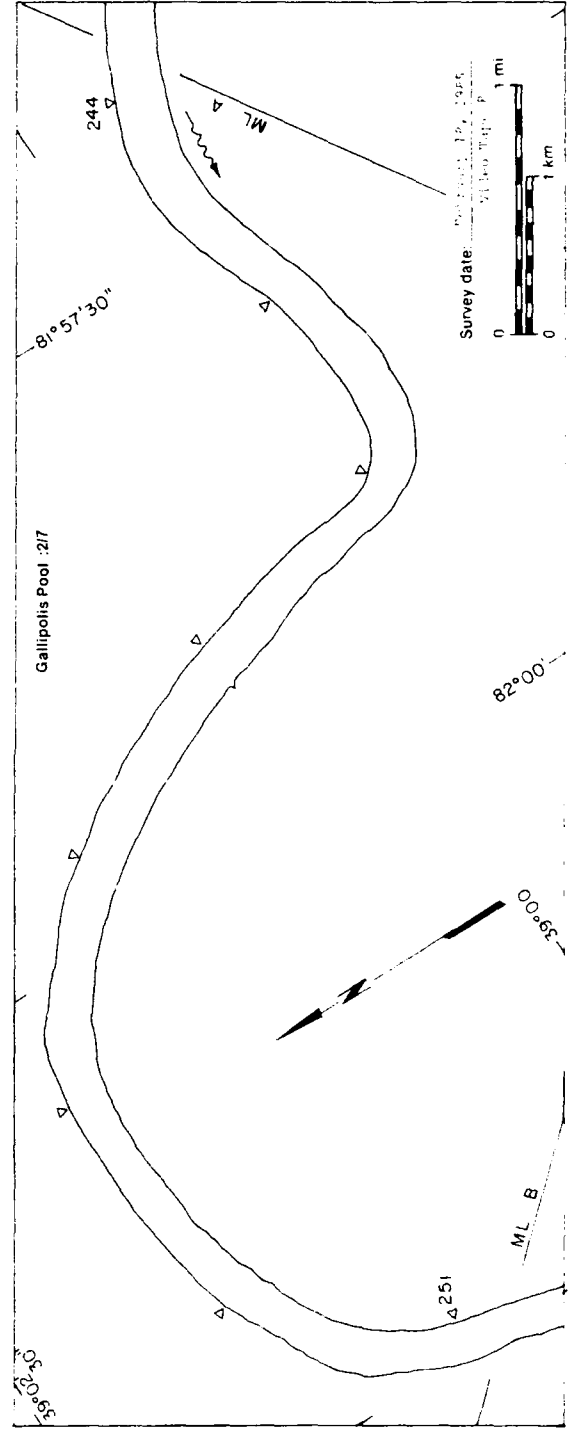
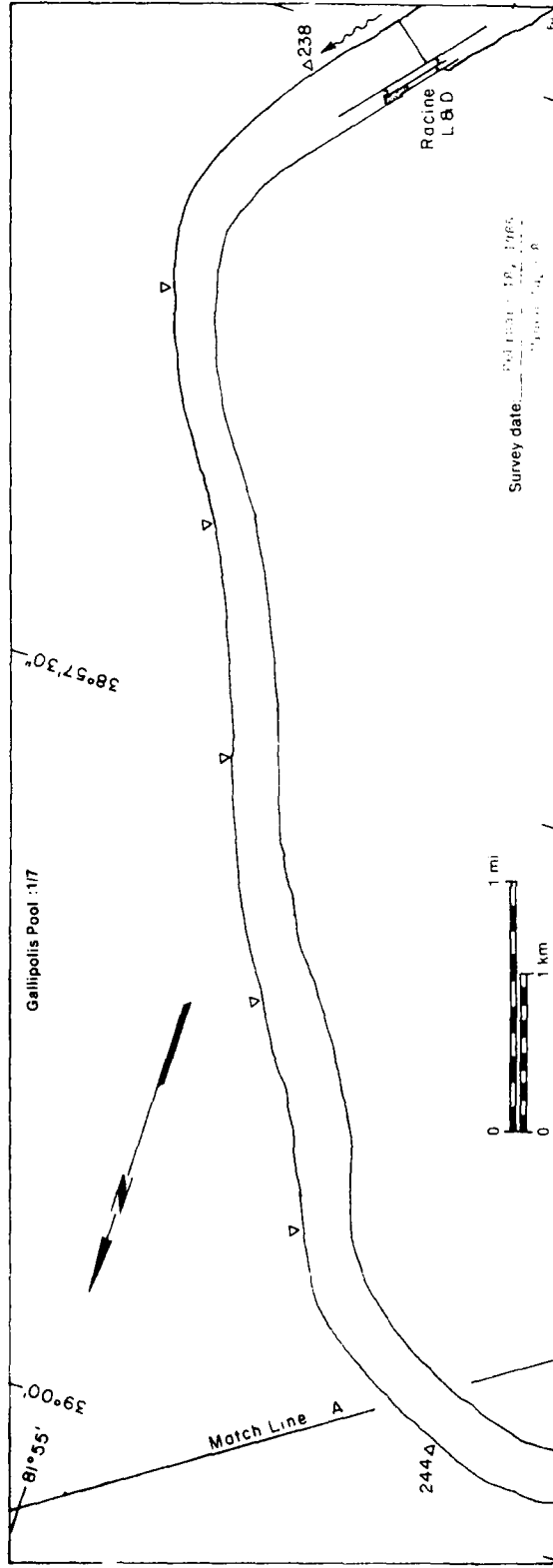
18 February 1985

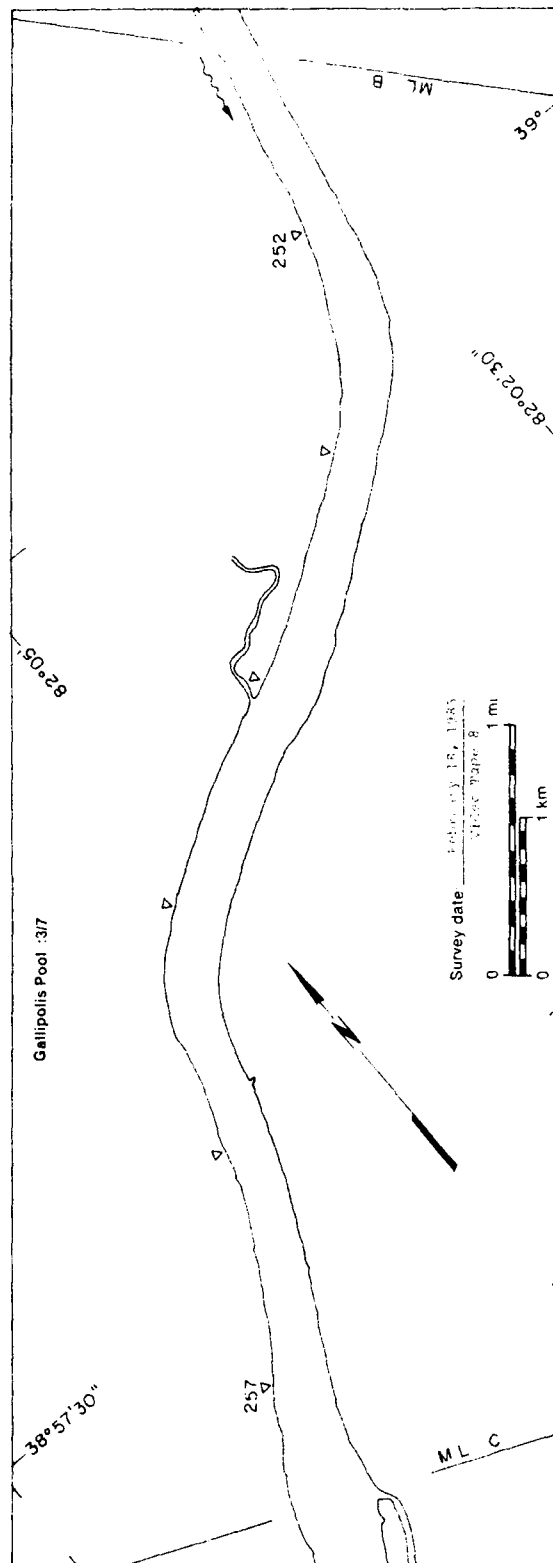




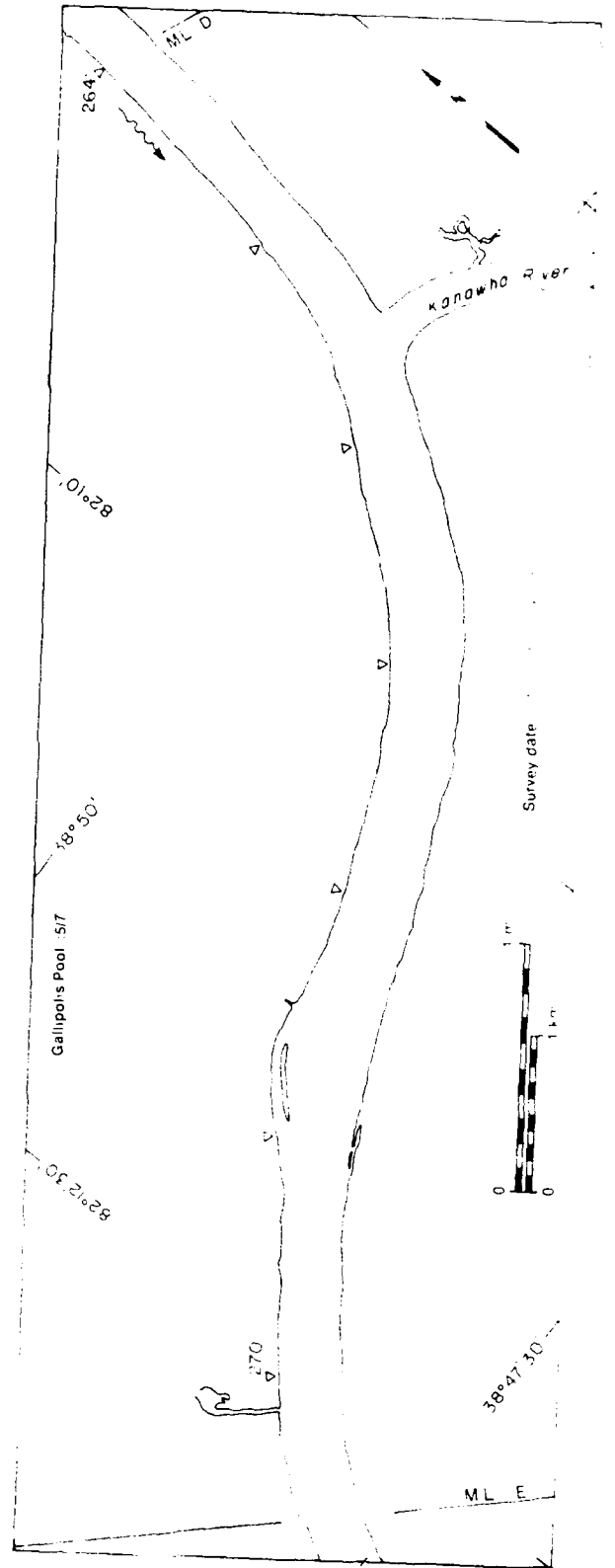
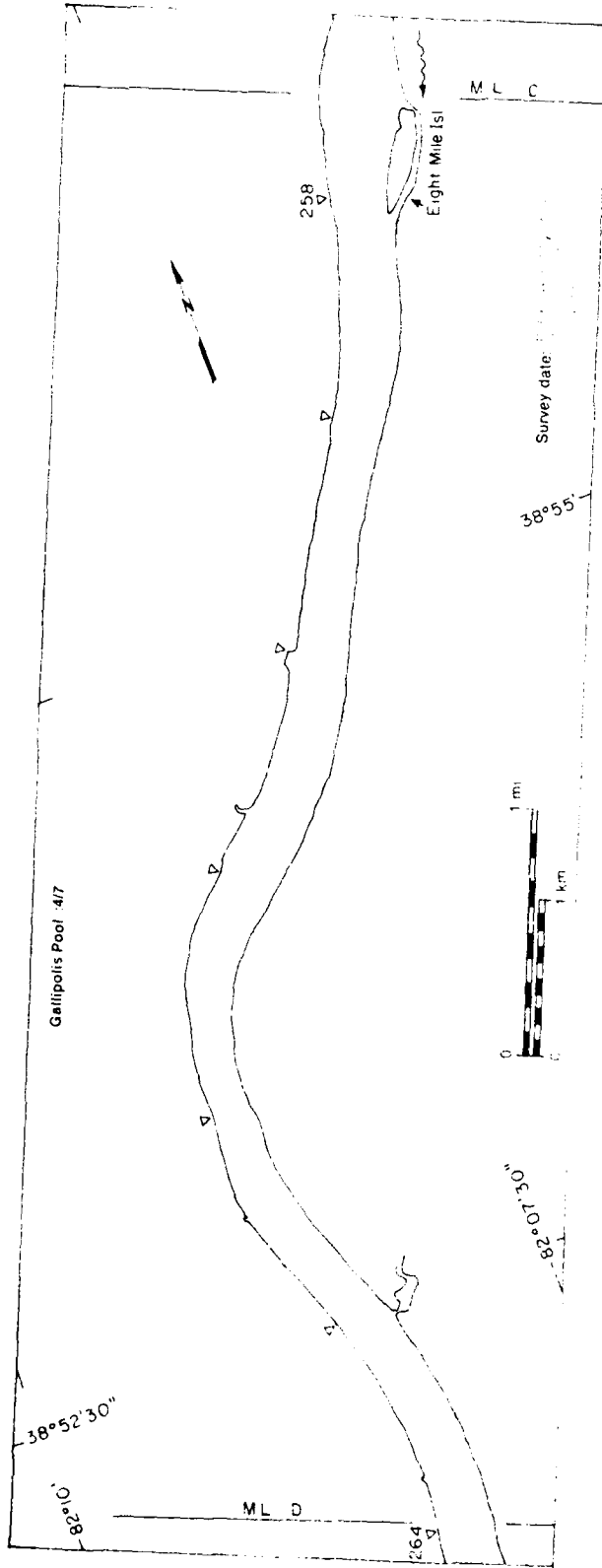
Racine Pool MAP UNITS	Area ($m^2 \times 10^6$)	Surface concentration (%)
Open water	19.51	NA
Solid ice cover	--	NA
Solid ice cover with open-water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	--	--
Ice floes or frazil slush and pans	0.18	5
Total Area ($m^2 \times 10^6$)	19.89	

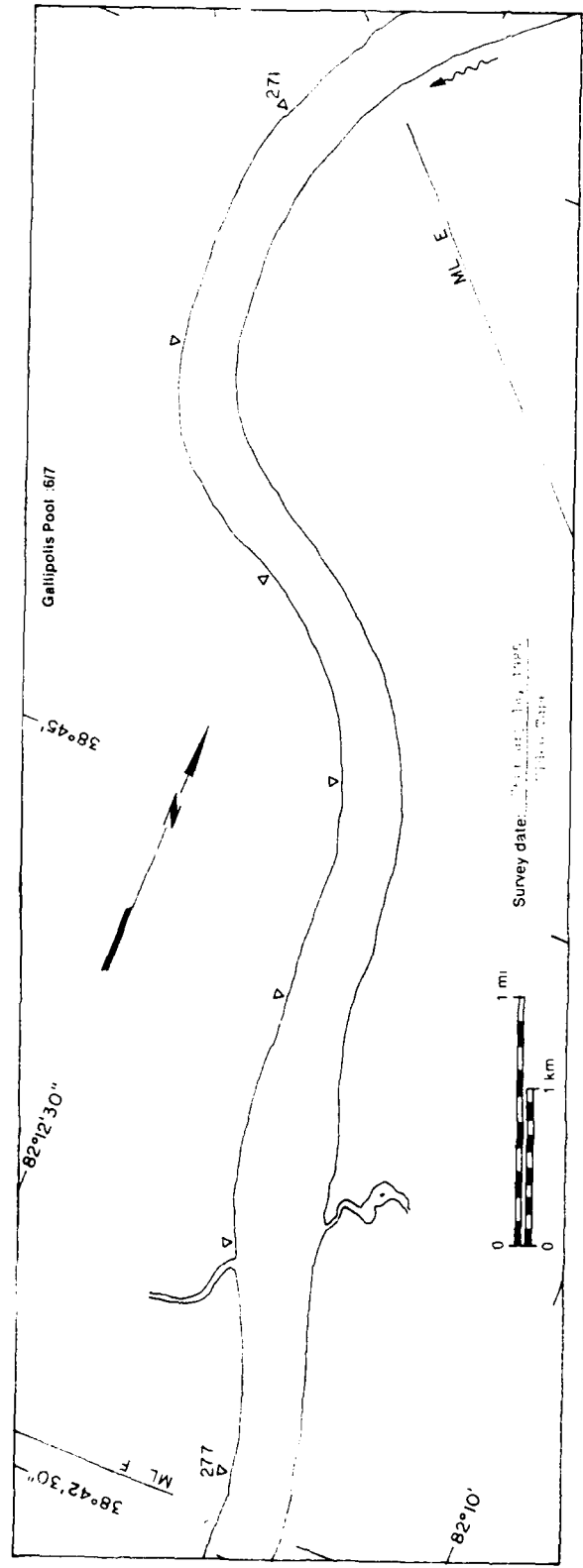
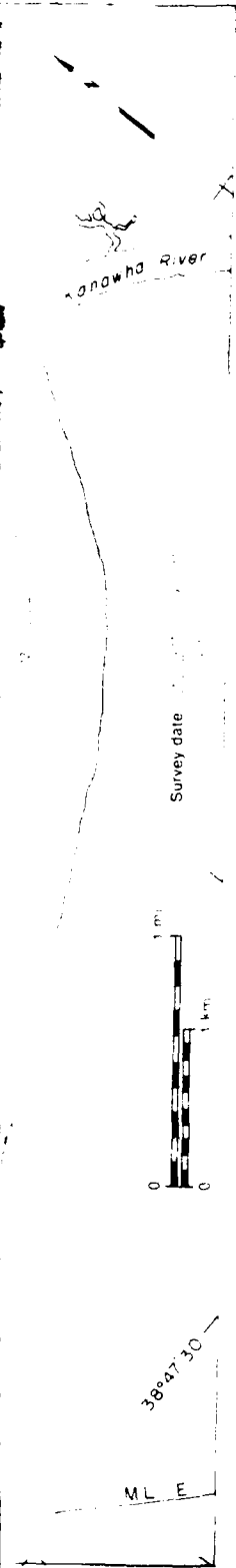
18 February 1985



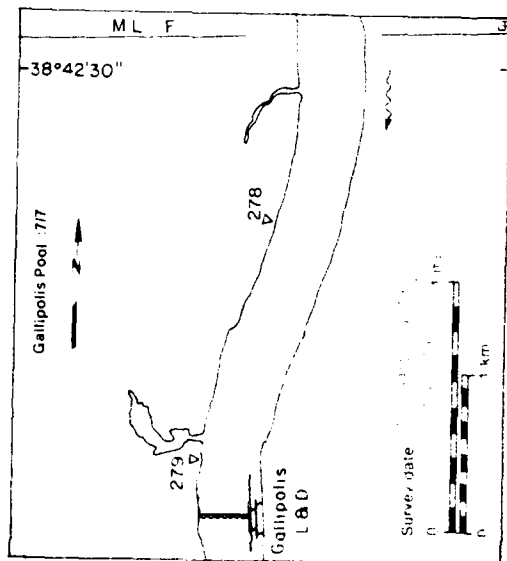


18 February 1985



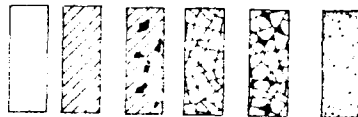


18 February 1985

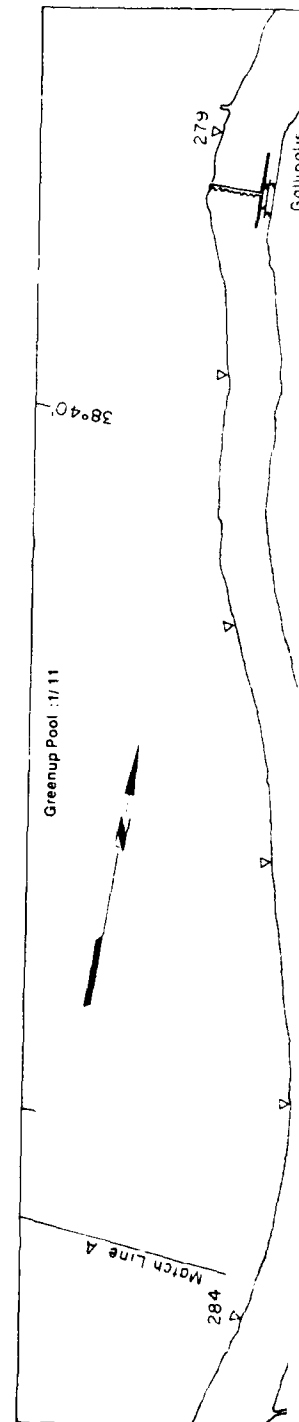


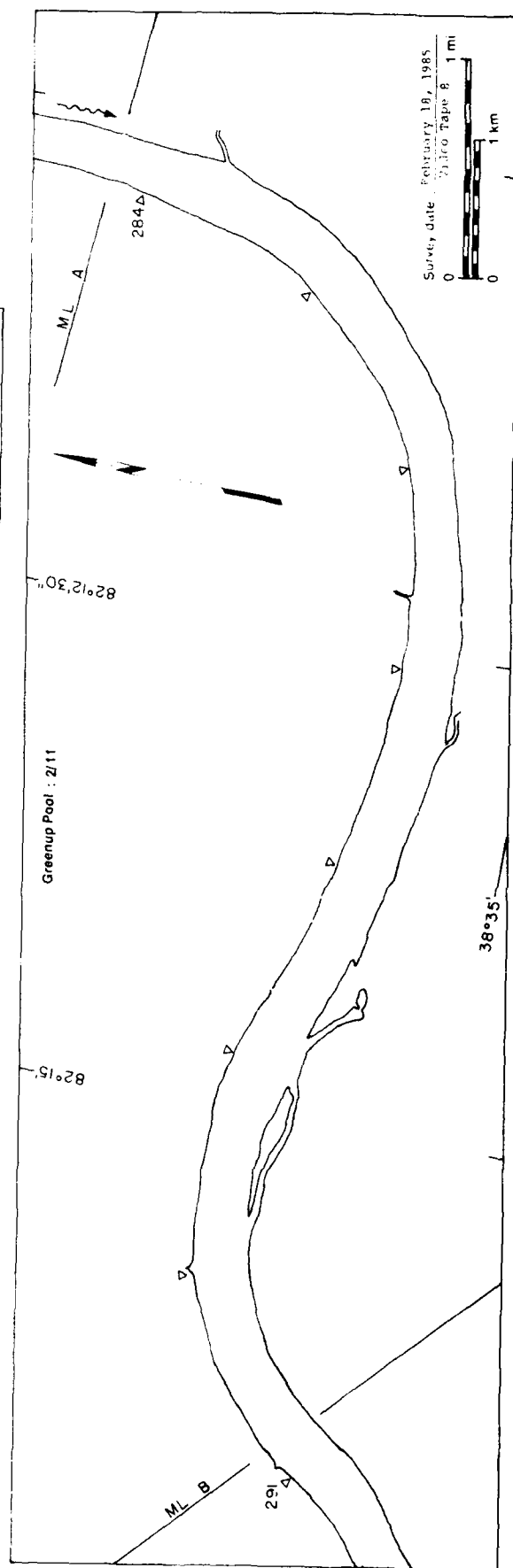
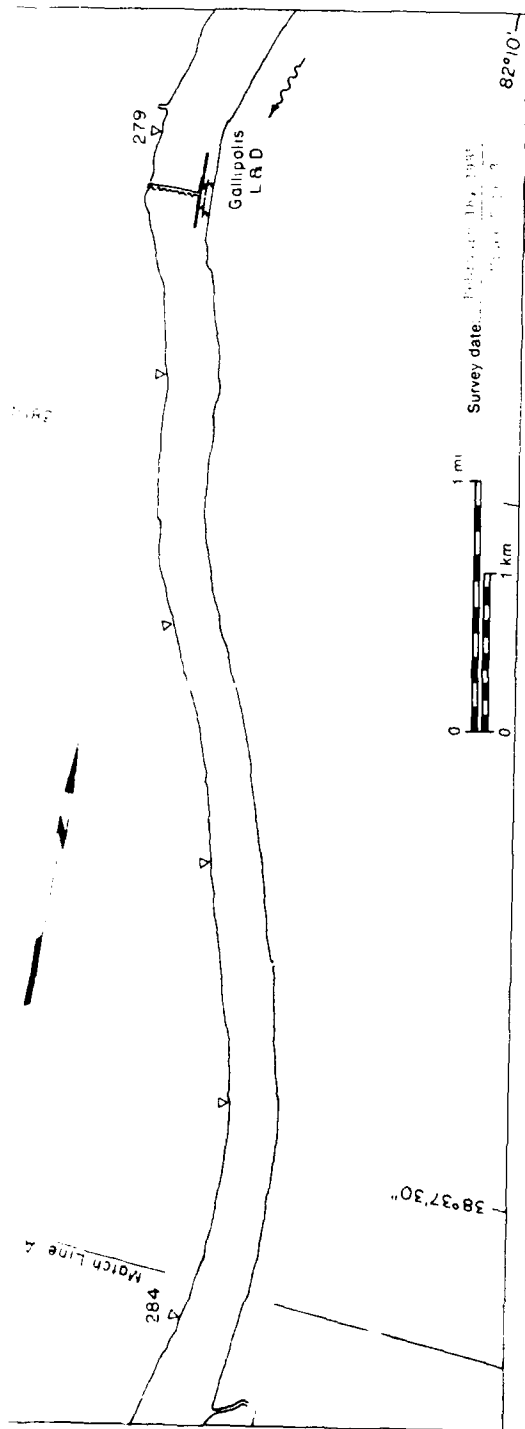
Gallipolis Pool

MAP UNITS

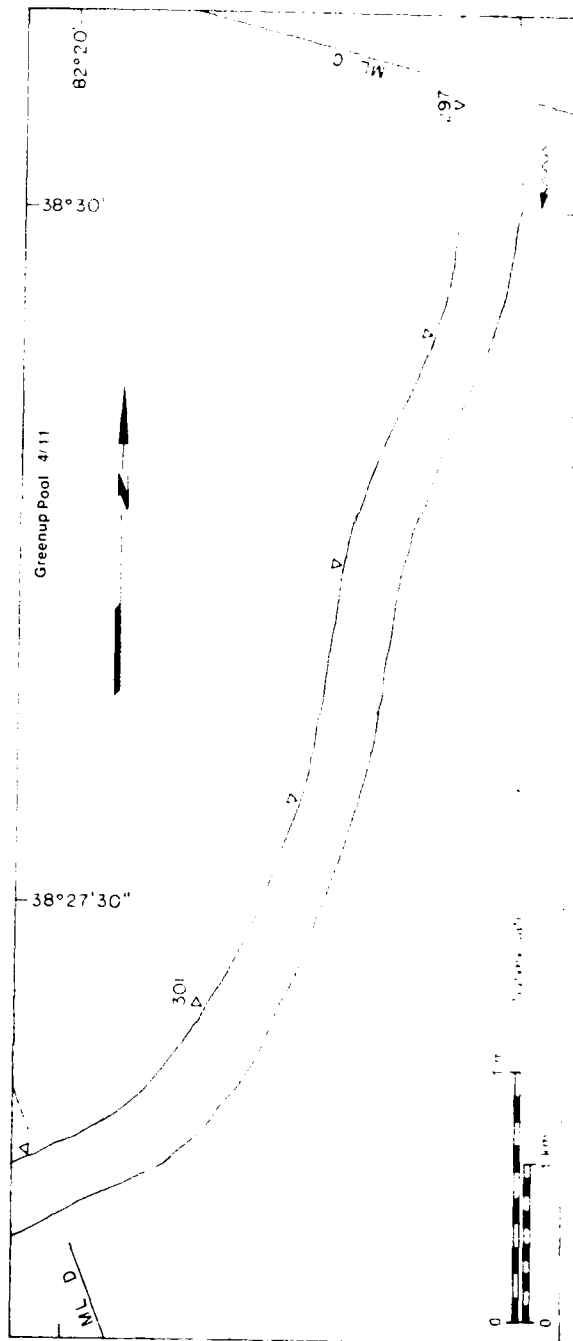
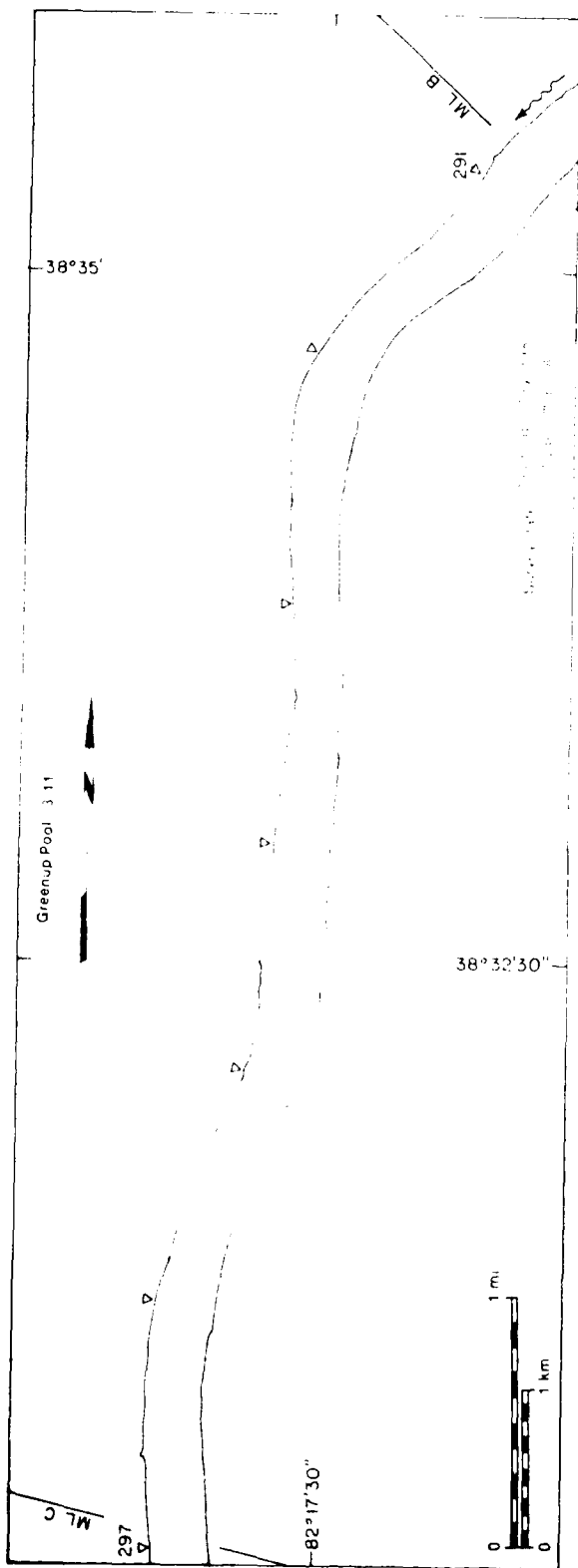


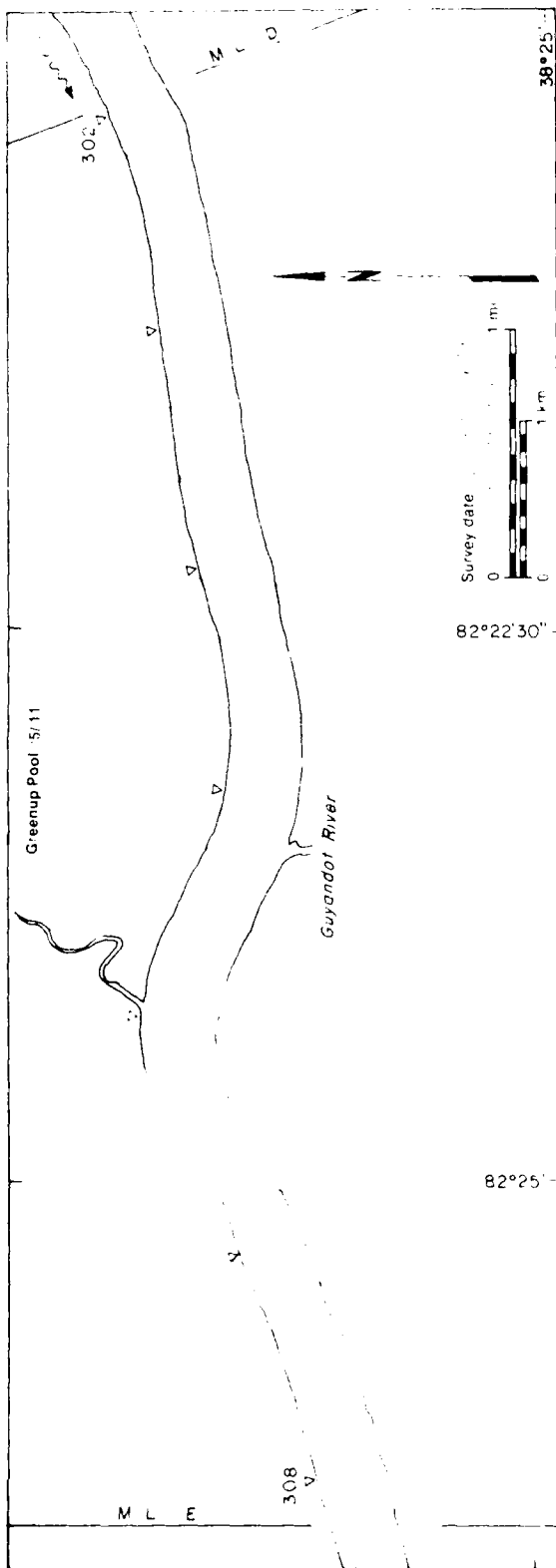
Open water	NA
Solid ice cover	NA
Solid ice cover with open water areas	---
Fragmented ice cover	---
Fragmented ice cover with open water areas	---
Ice floes or trails with and pans	---



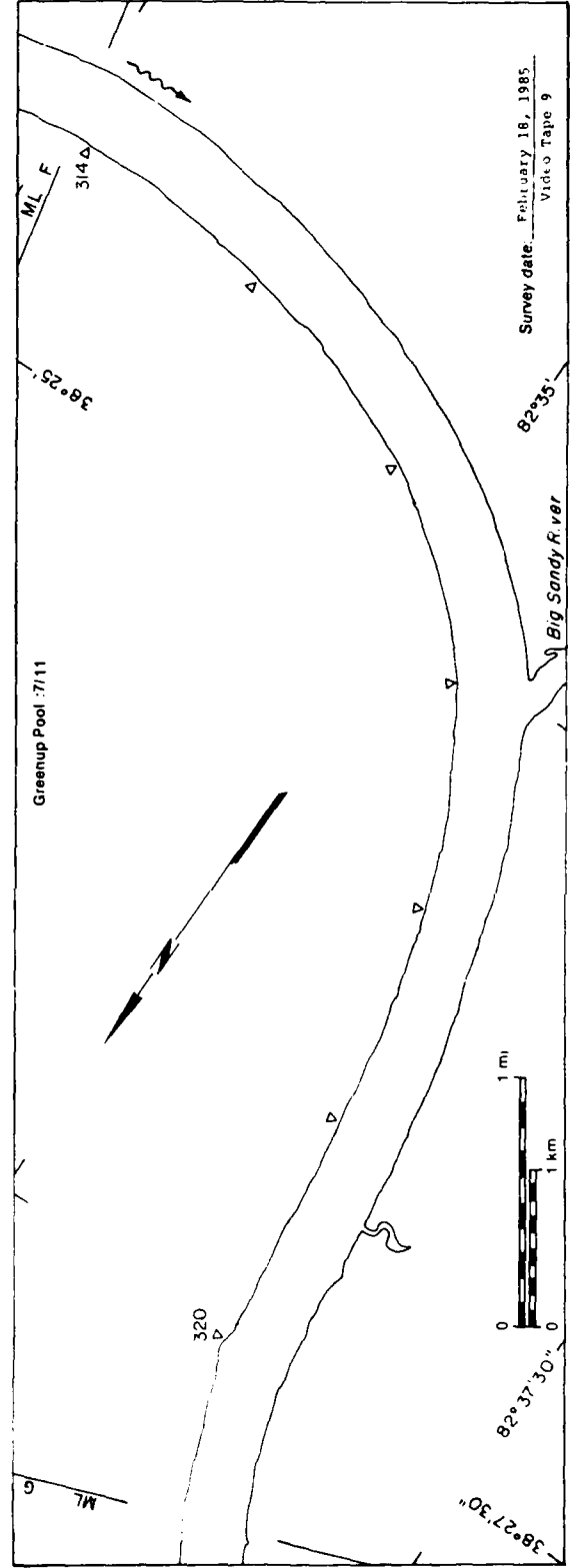
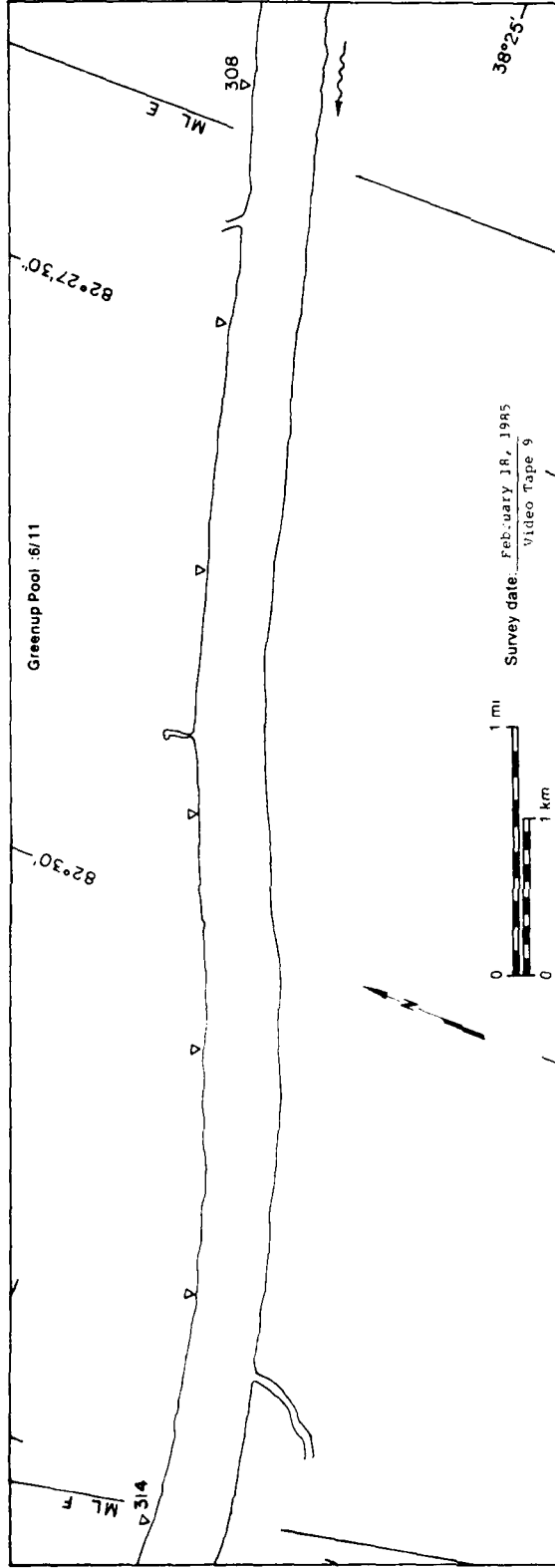


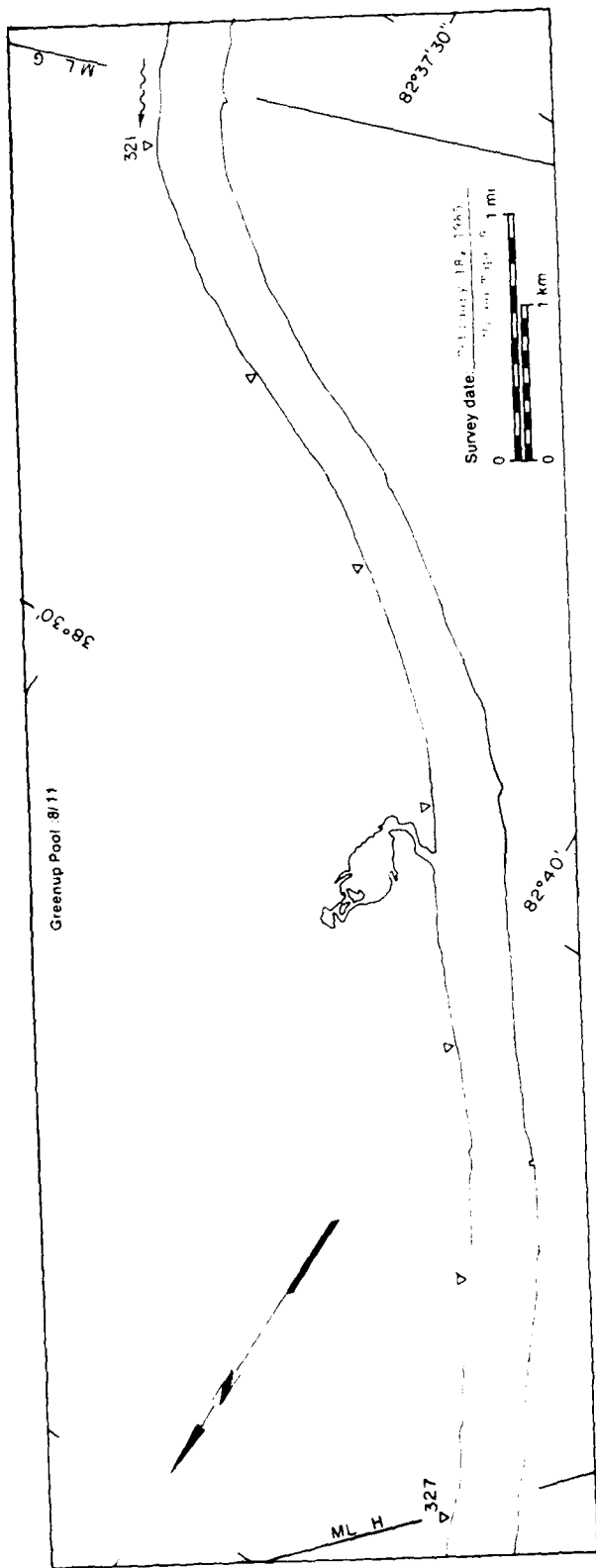
18 February 1985



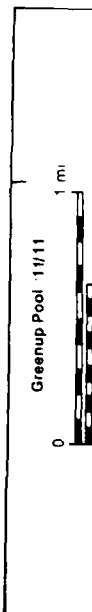
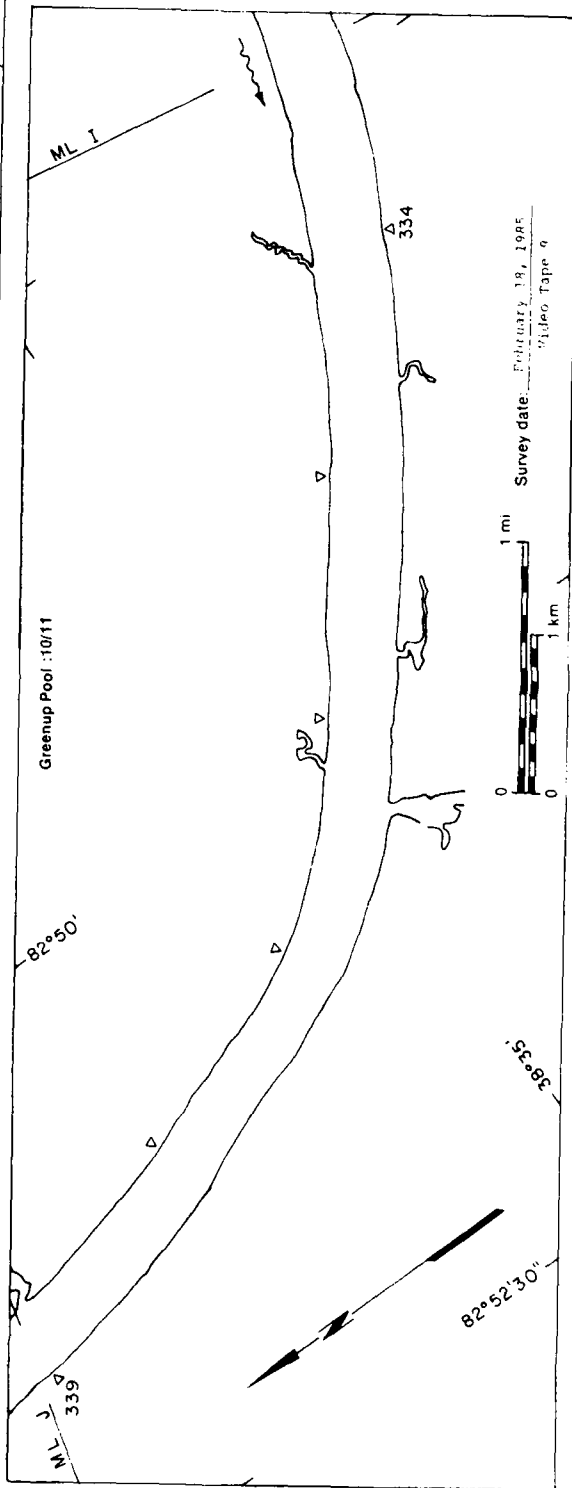
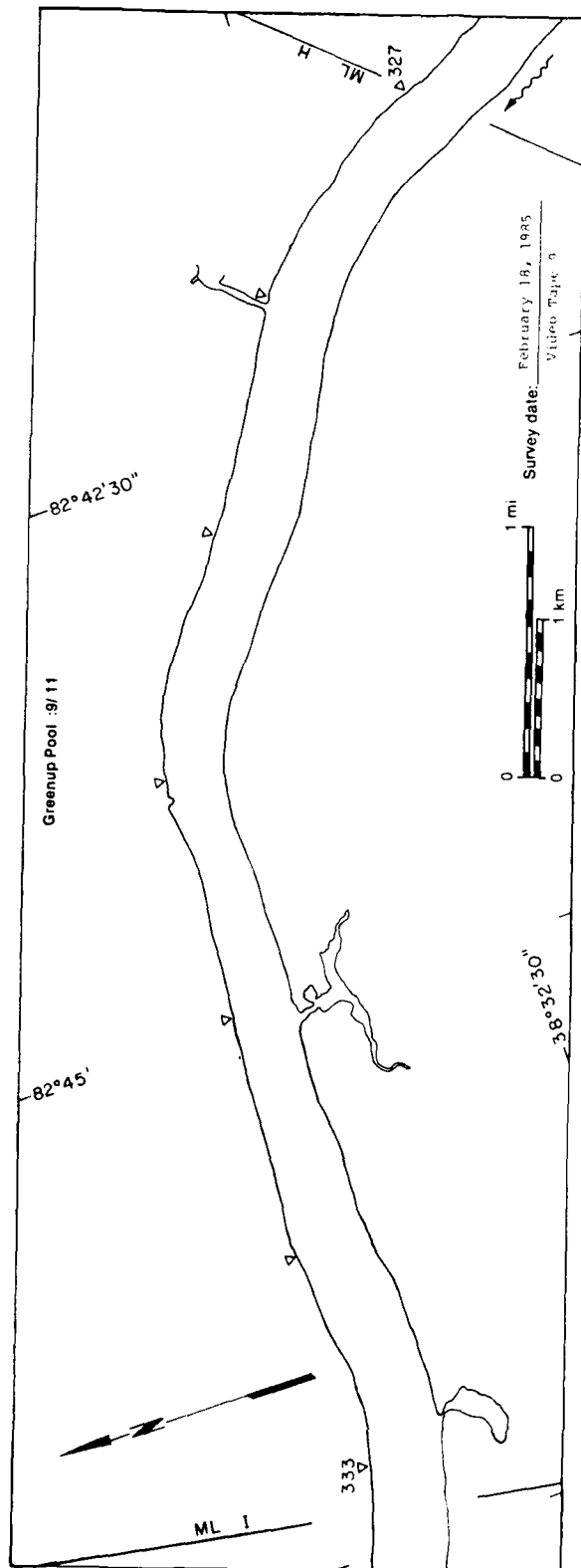


18 February 1985





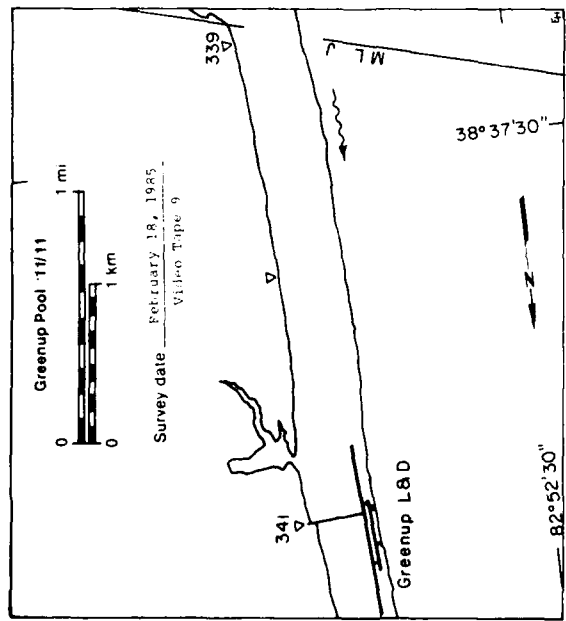
18 February 1985



Greenup Pool

Survey date

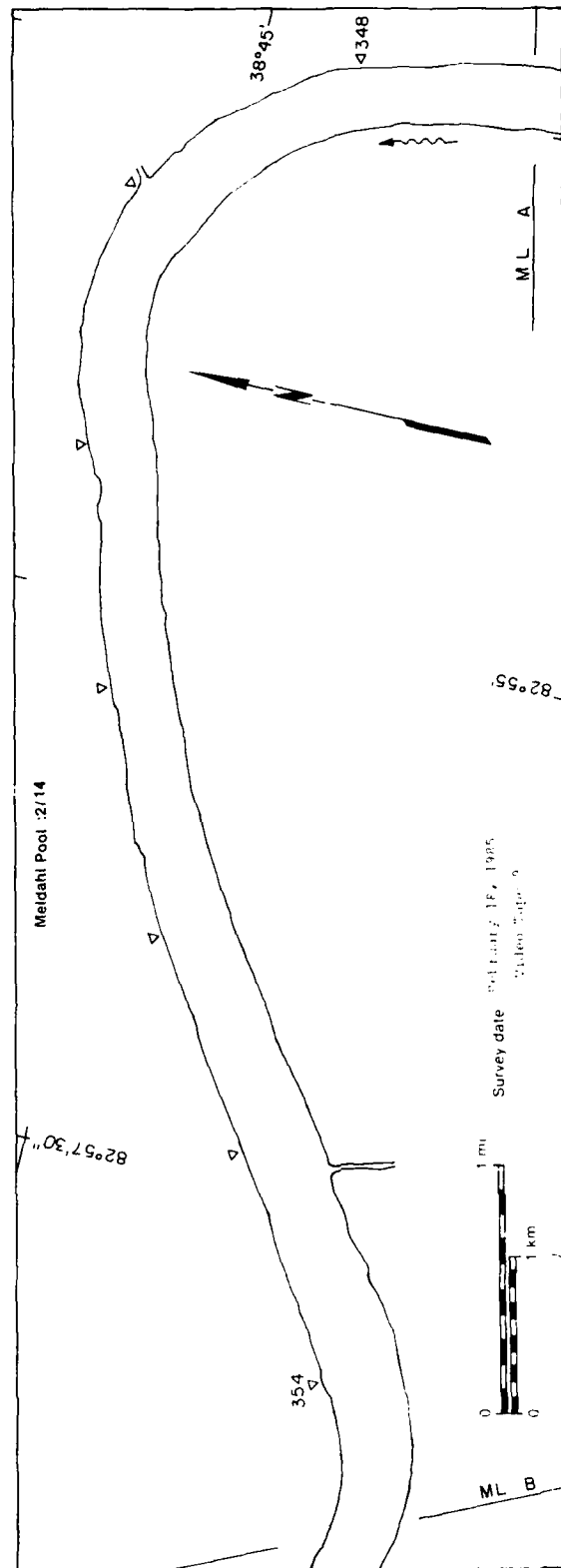
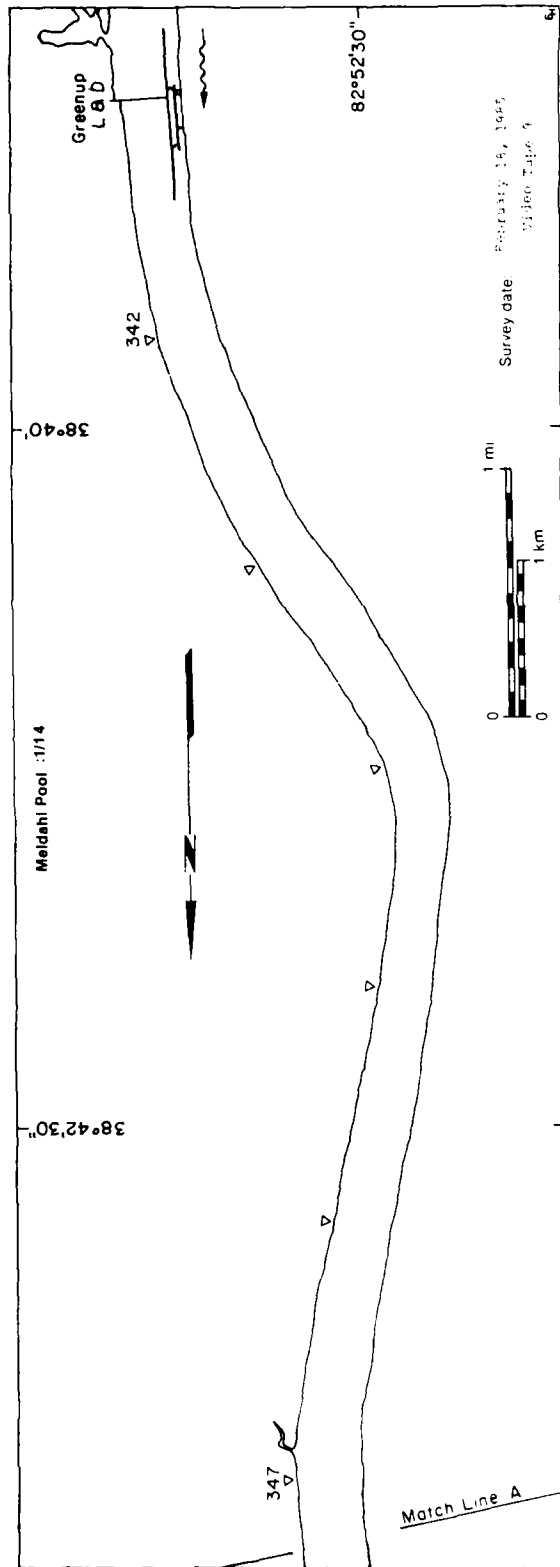
82°52'30"
38°35'

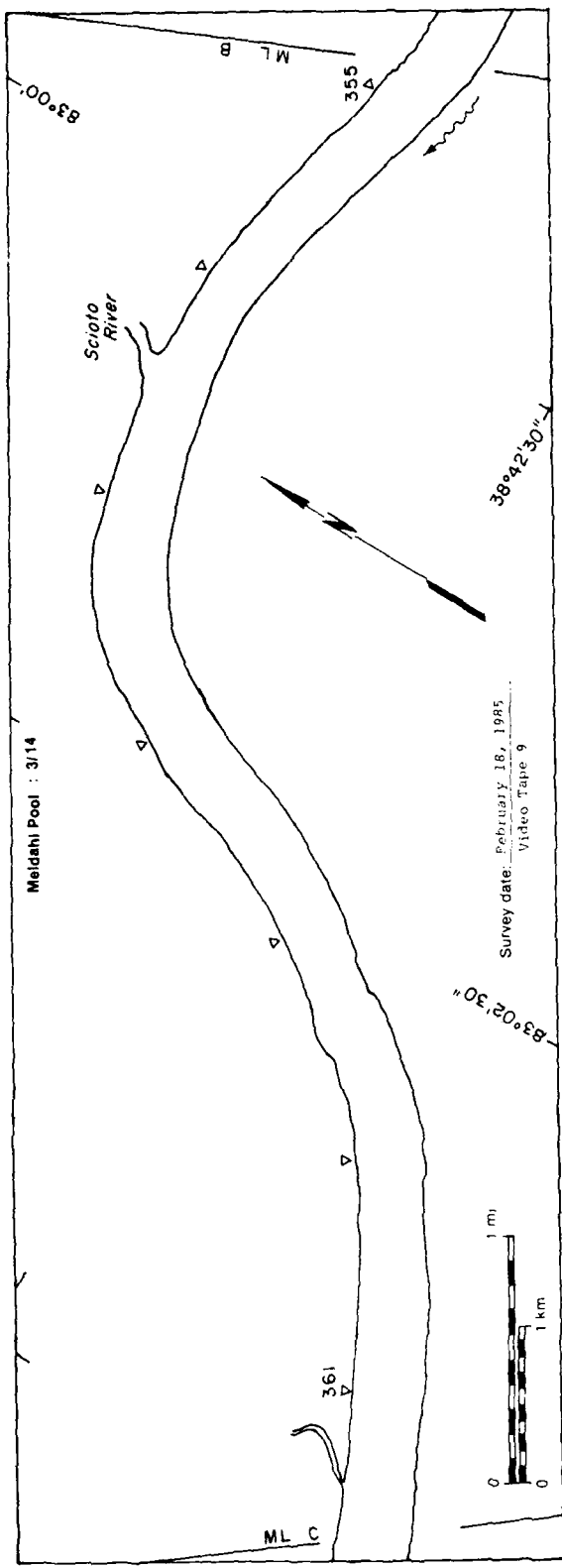
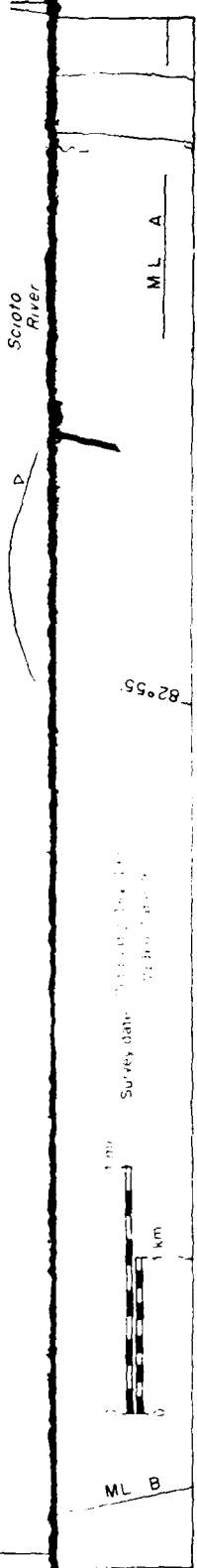


Greenup Pool

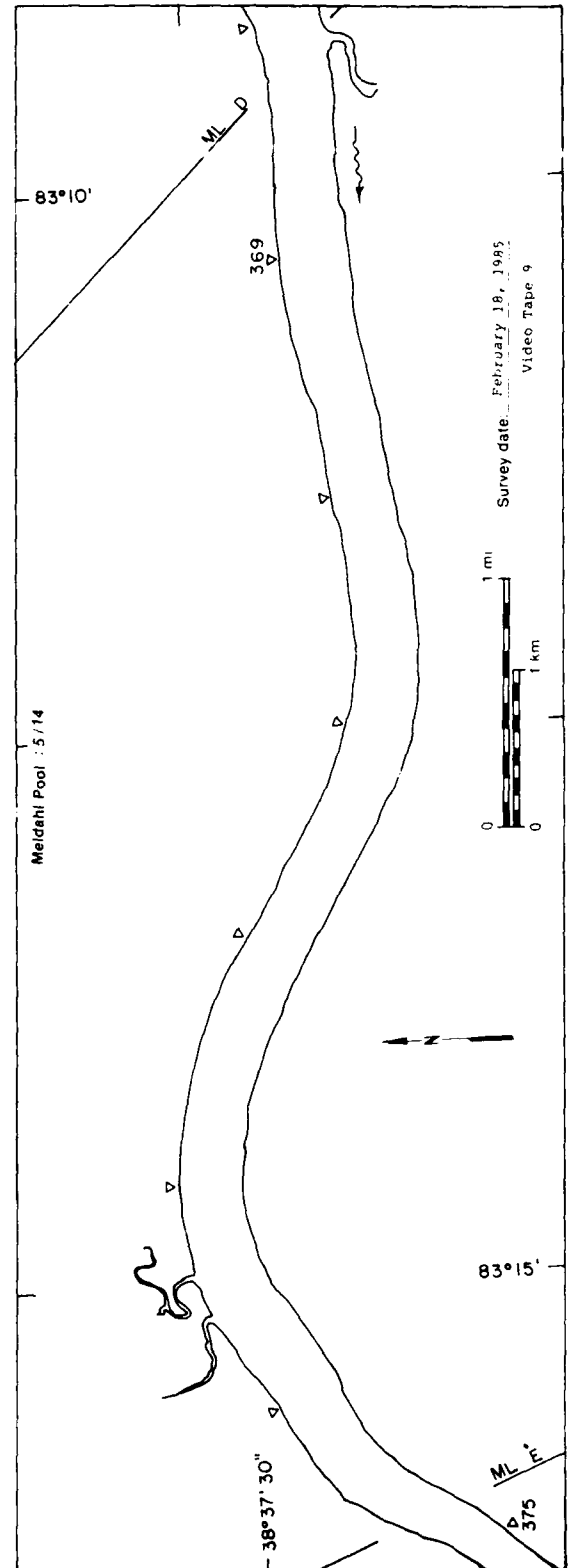
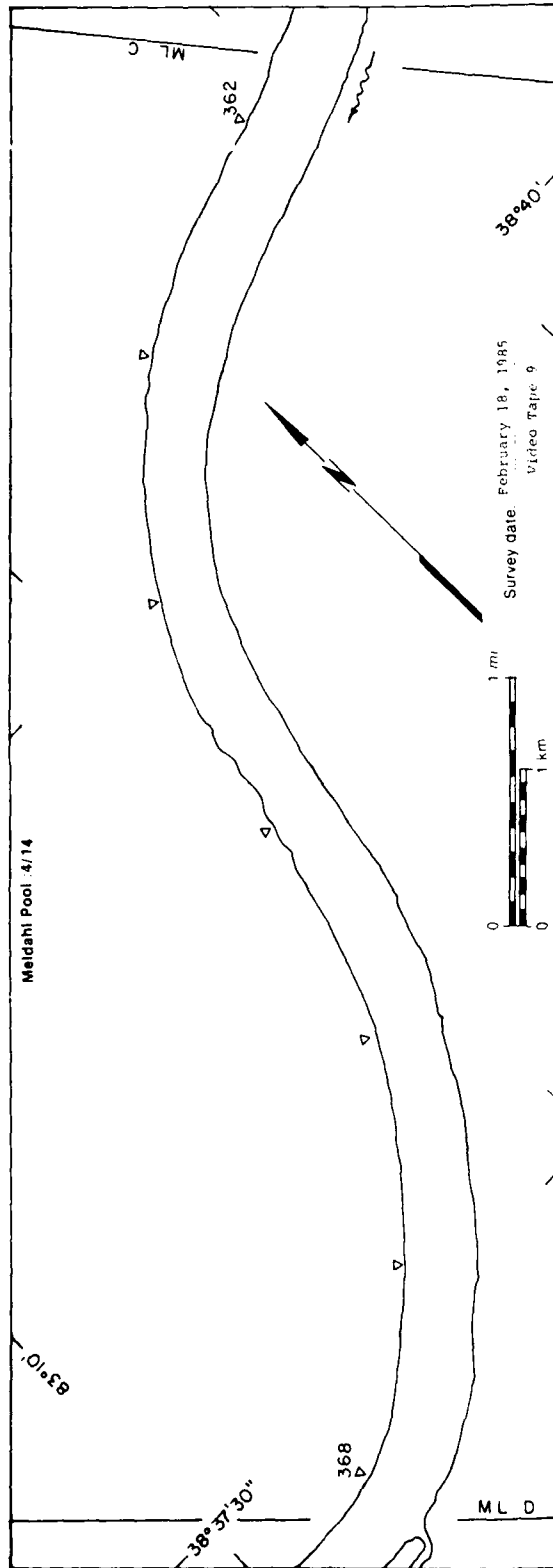
MAP UNITS		Surface concentration ($\text{m}^2 \times 10^6$)	NA
	Open water	41.19	NA
	Solid ice cover	--	NA
	Solid ice cover with open-water areas	--	--
	Fragmented ice cover	--	NA
	Fragmented ice cover with open-water areas	--	--
	Ice floes or frazil slush and pans	--	--
Total Area ($\text{m}^2 \times 10^6$)		41.19	

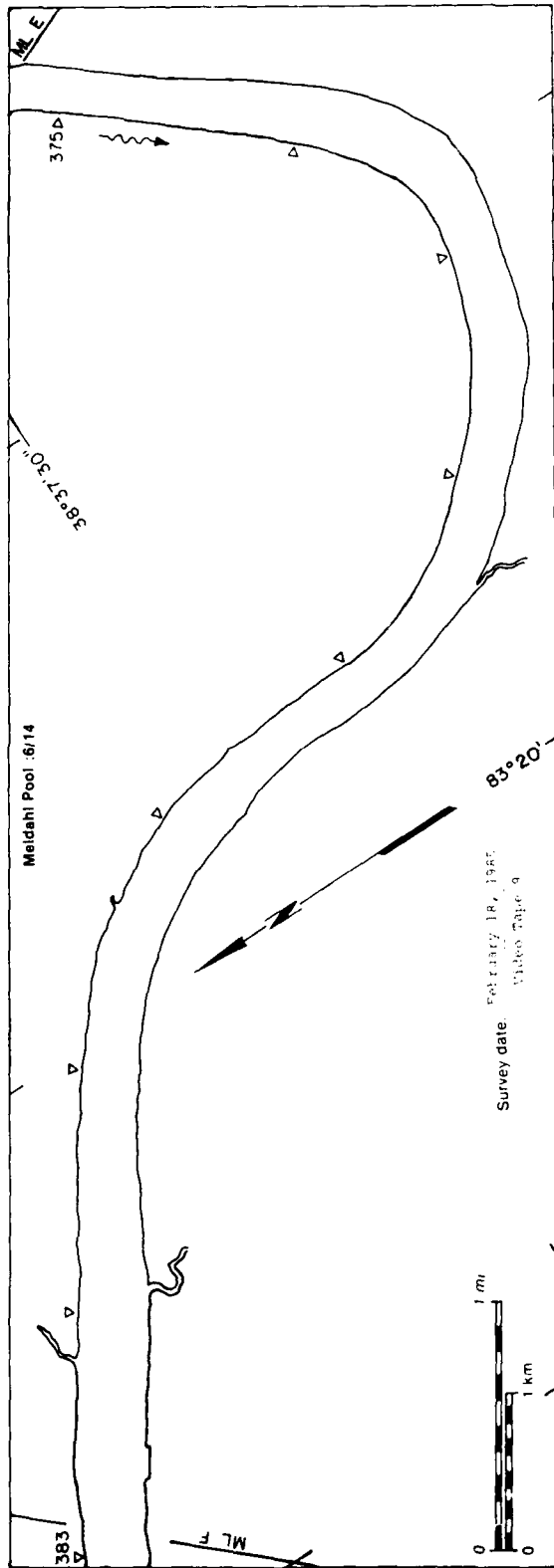
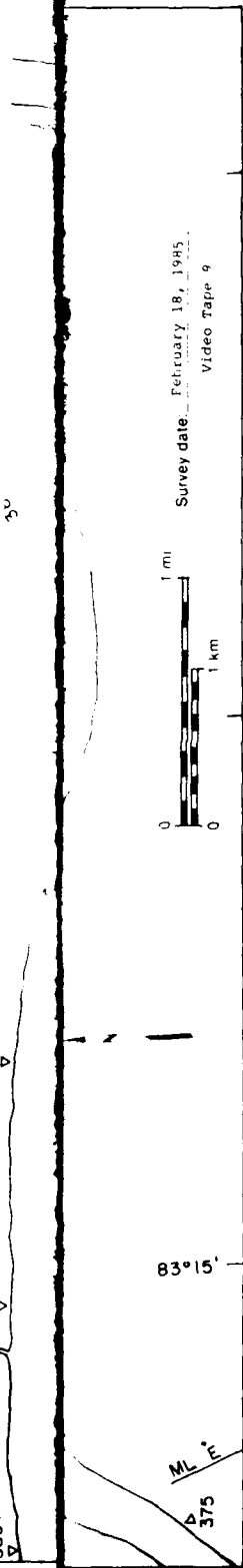
18 February 1985



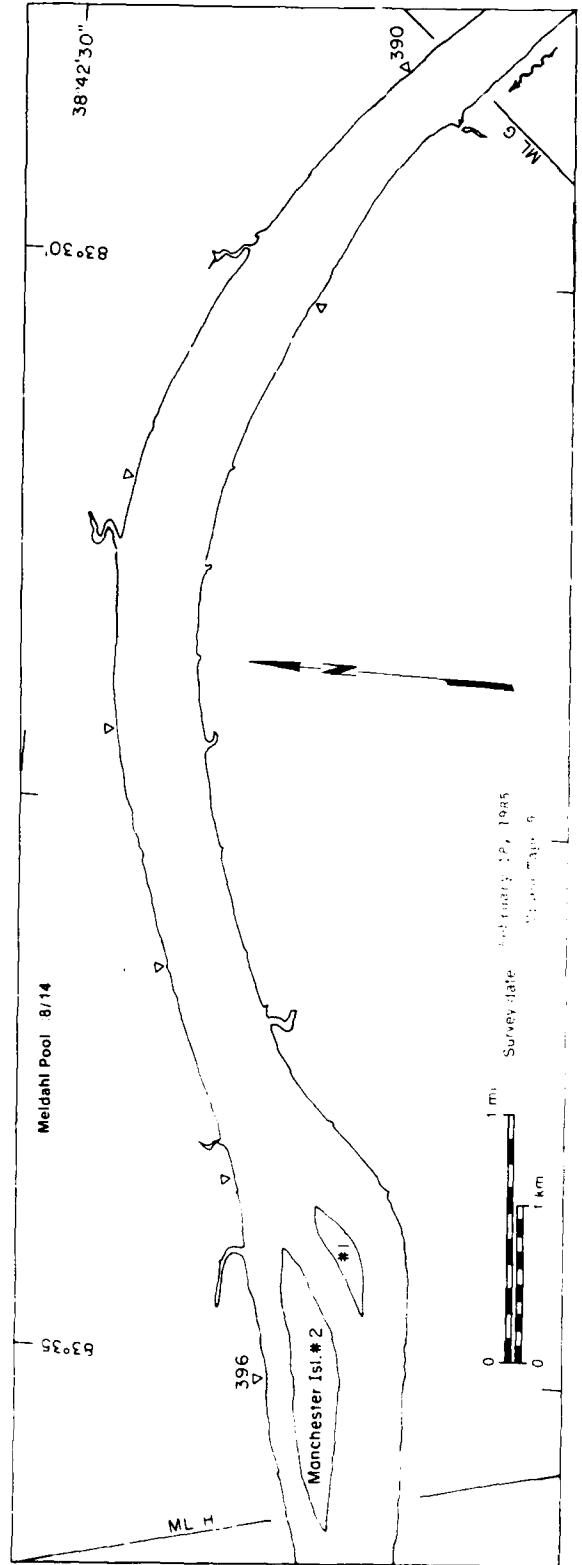
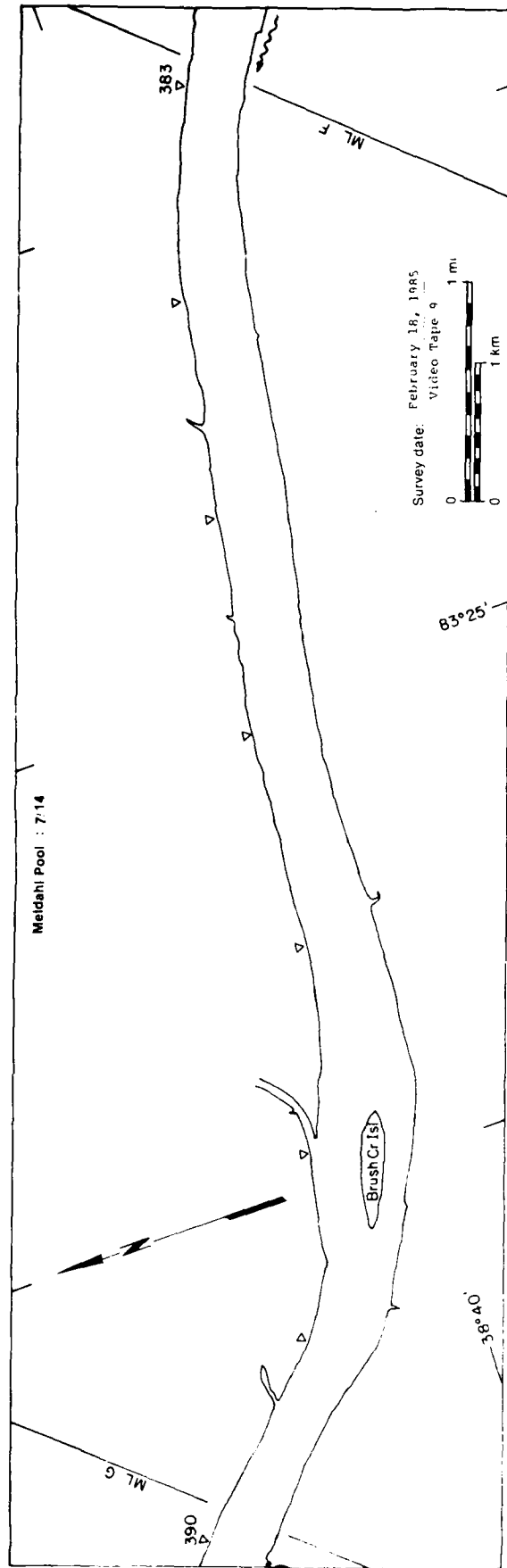


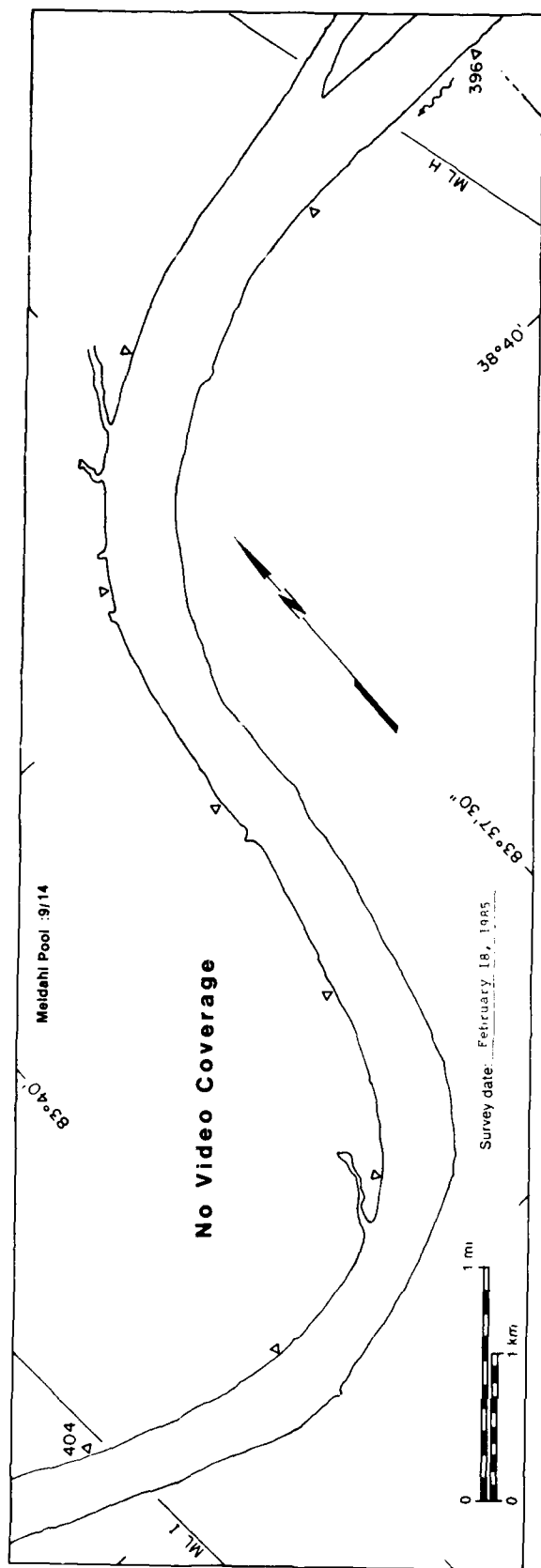
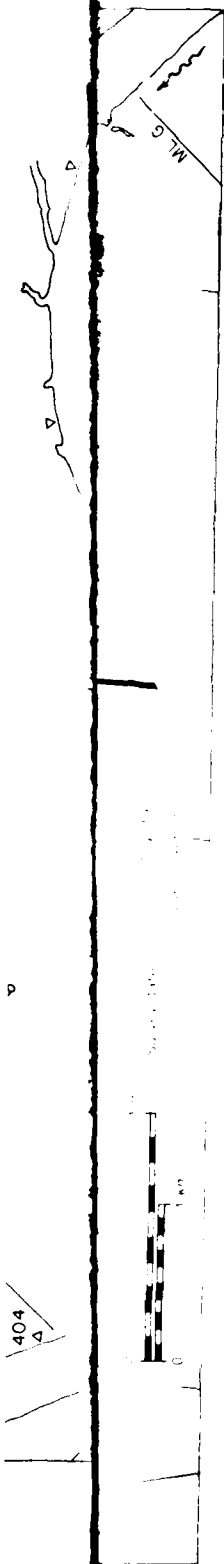
18 February 1985



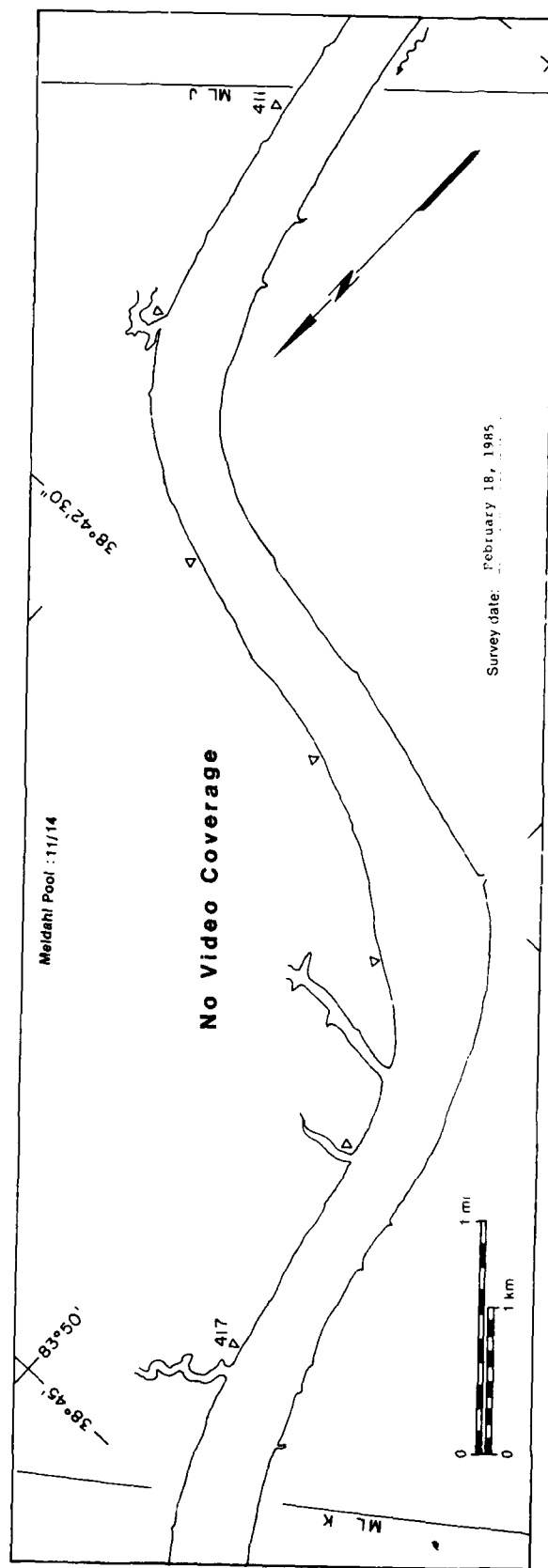
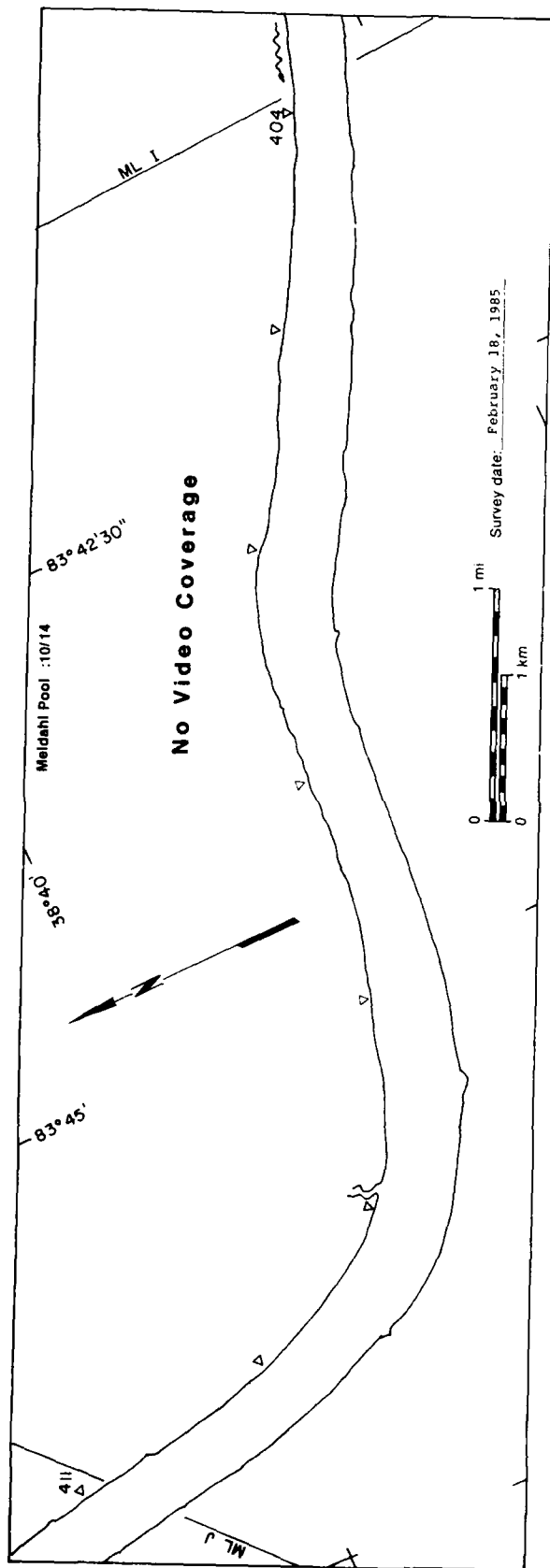


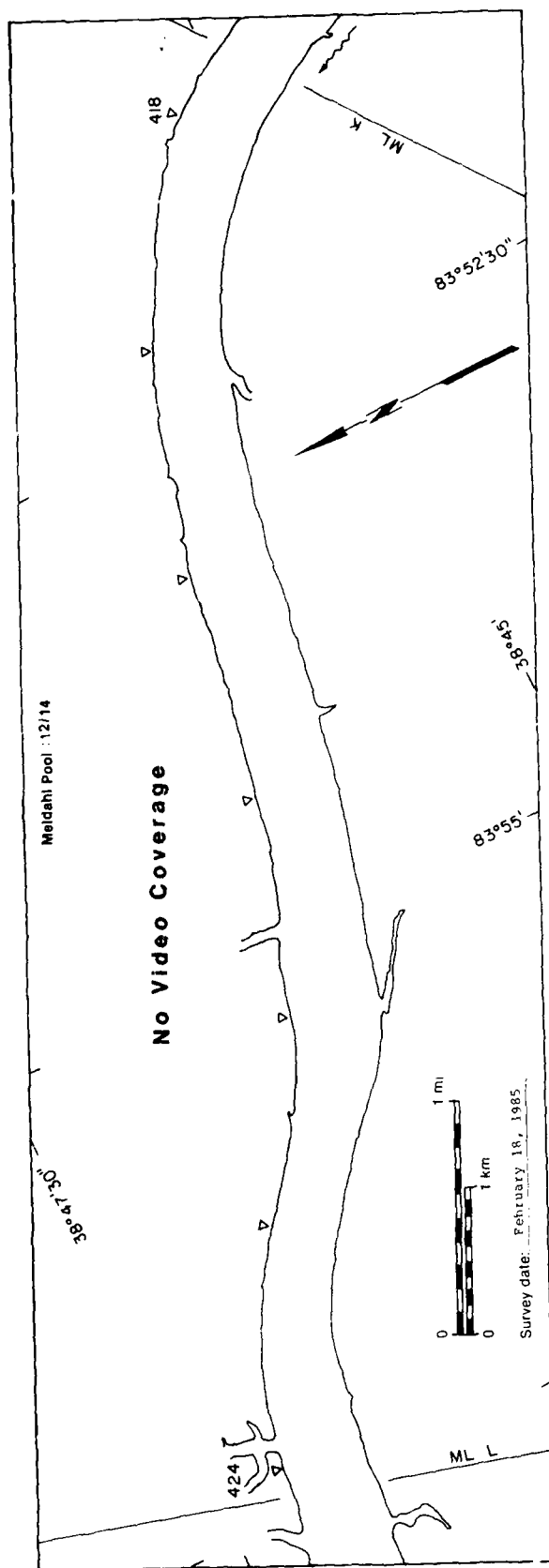
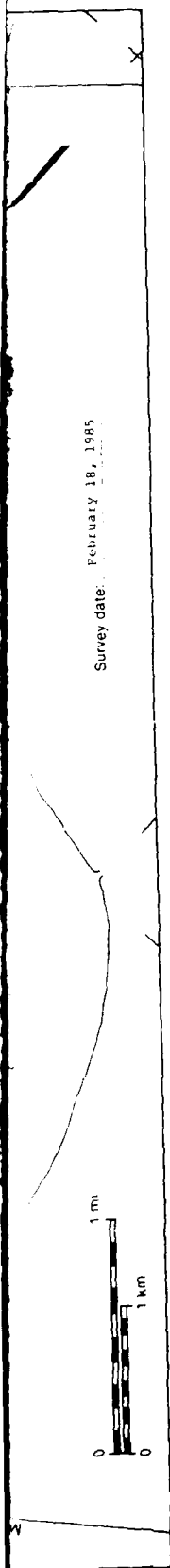
18 February 1985





18 February 1985





Map of the Merald Pool area showing a survey track. The track is marked with points 425 and 431. The area is labeled "No Video Coverage". The map includes a north arrow, a scale bar (0 to 1 mile and 0 to 1 kilometer), and a survey date of February 16, 1995. The map also shows the coastline and a line labeled "ML L".

Meidahl Pool 14/14

No Video Coverage

Captain Anthony
Meidahl 436
L & D

38°47'30"

ML M

431

84°05'

84°10'

Survey date February 18, 1965




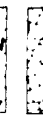
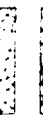

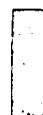
1 m 1 km

Medahl Pool

44°05'

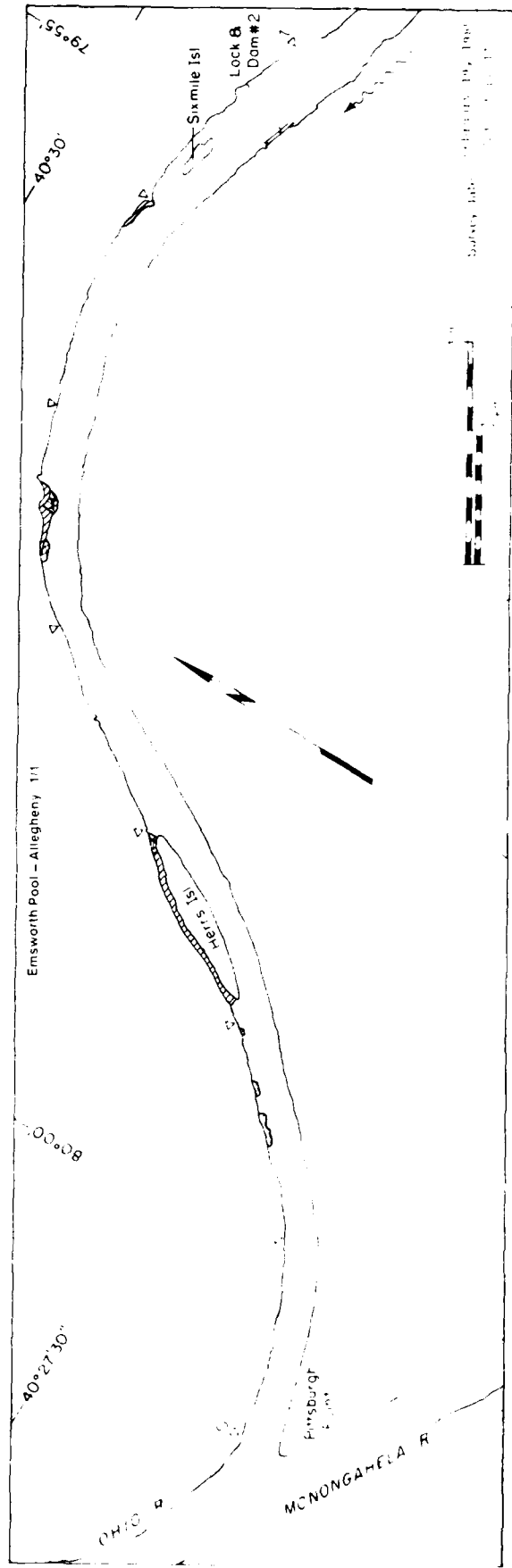
Meliant Pool

MAP SHEET

	Open water
	Shrub vegetation
	Scattered trees with open water areas
	Scattered trees
	Scattered trees with open water areas
	Scattered trees with open water areas
	Scattered trees with open water areas

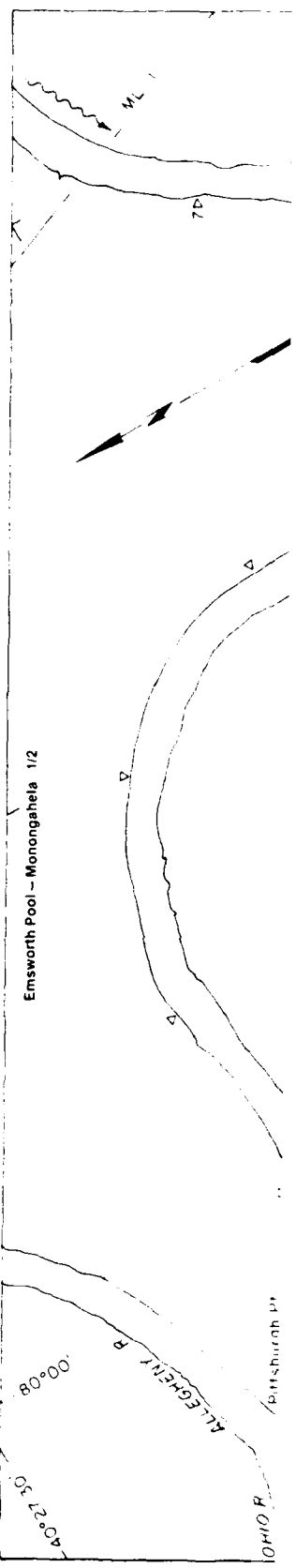
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA

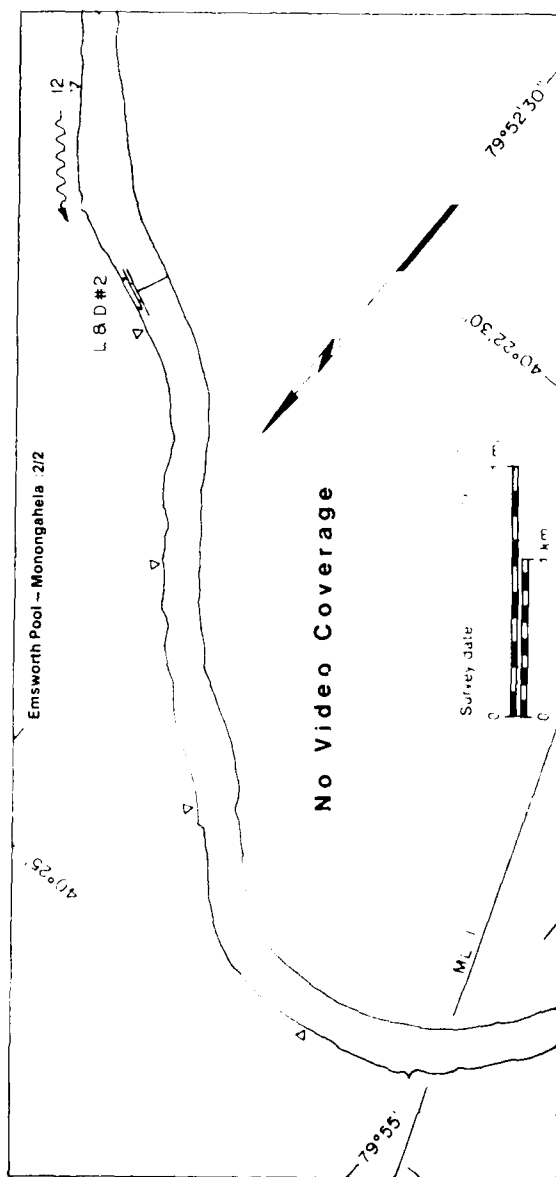
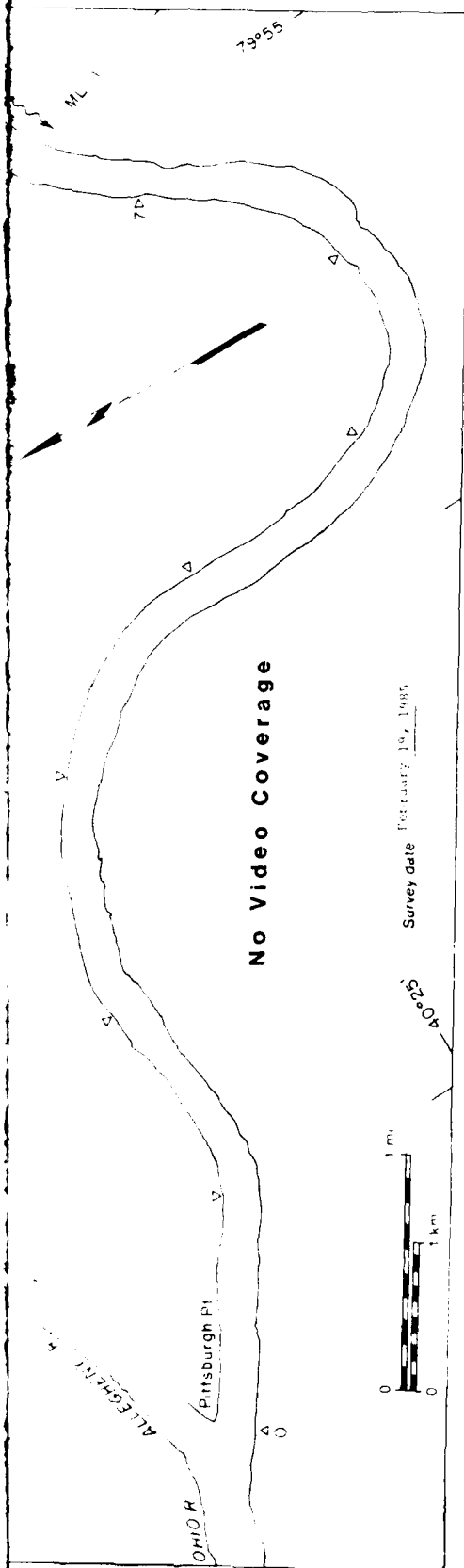
19 February 1985



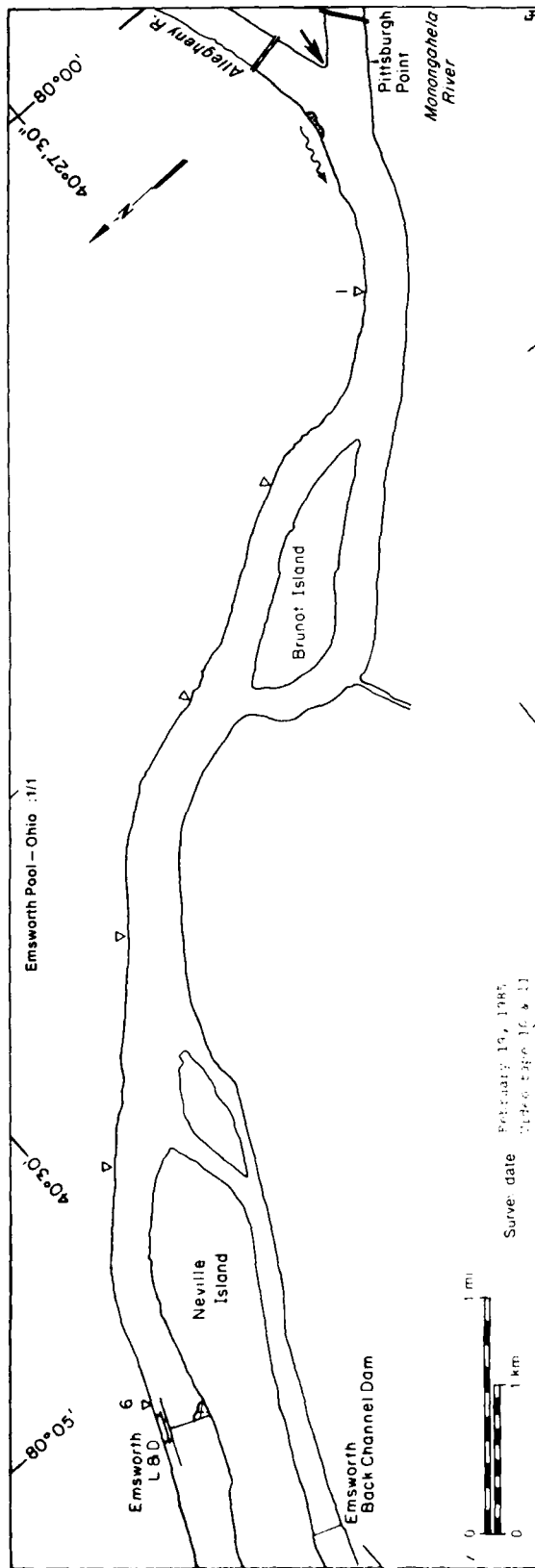
Emsworth Pool - Monongahela

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----





19 February 1985

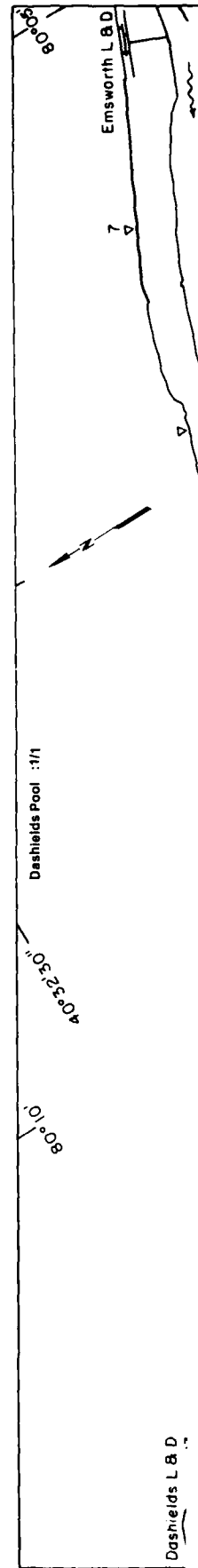


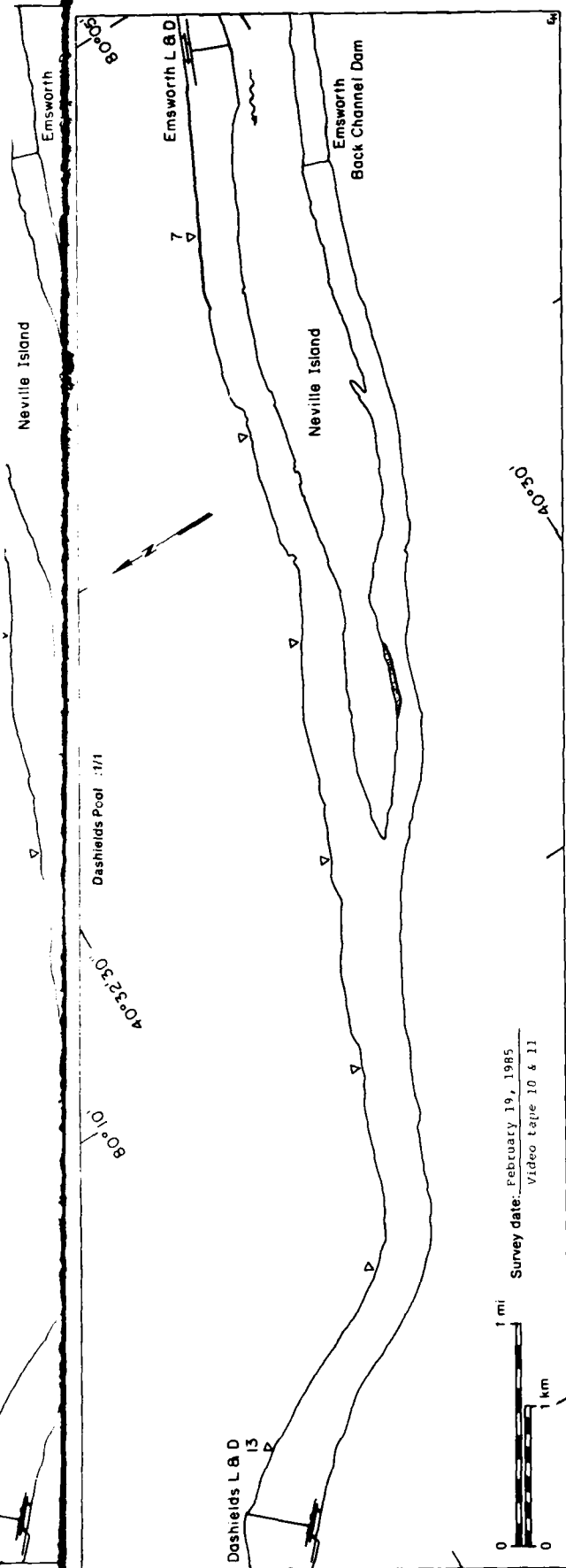
Survey date: February 19, 1985
 Sheet 16 of 17

Emsworth Pool - Ohio

MAP UNITS	Area, $\text{km}^2 \times 10^6$	Surface concentration, %
Open water	4.37	NA
Solid ice cover	—	NA
Solid ice cover with open water areas	—	—
Fragmented ice cover	0.02	NA
Fragmented ice cover with open water areas	—	—
Ice bars or frazil slush and pans	0.01	2
	4.42	

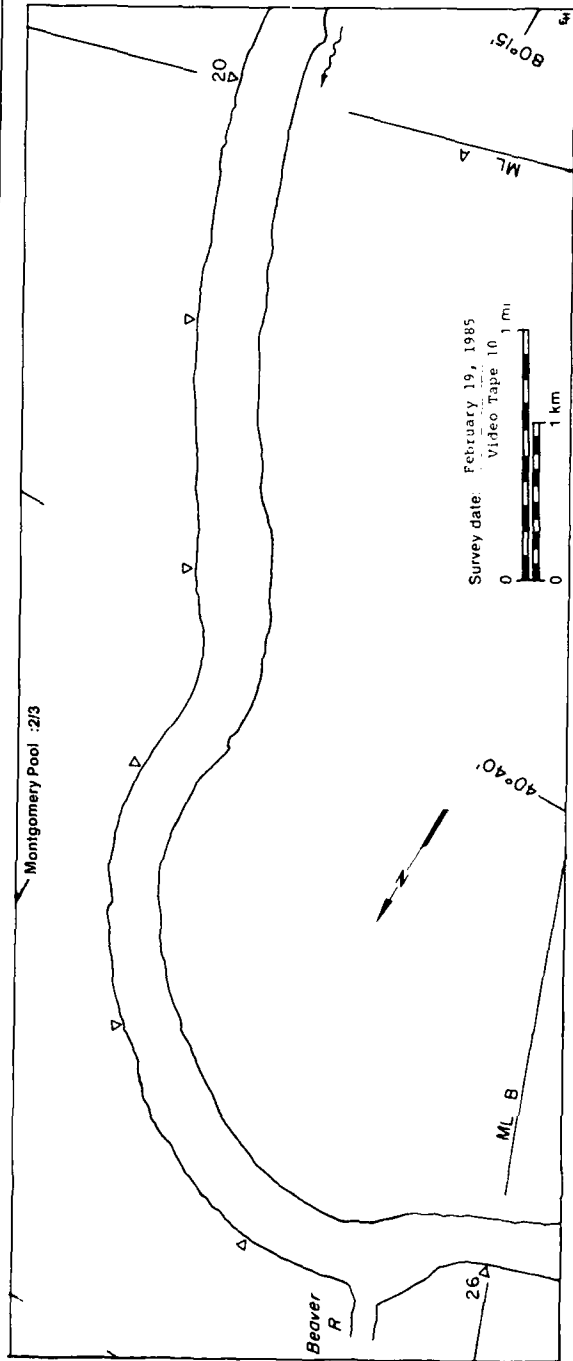
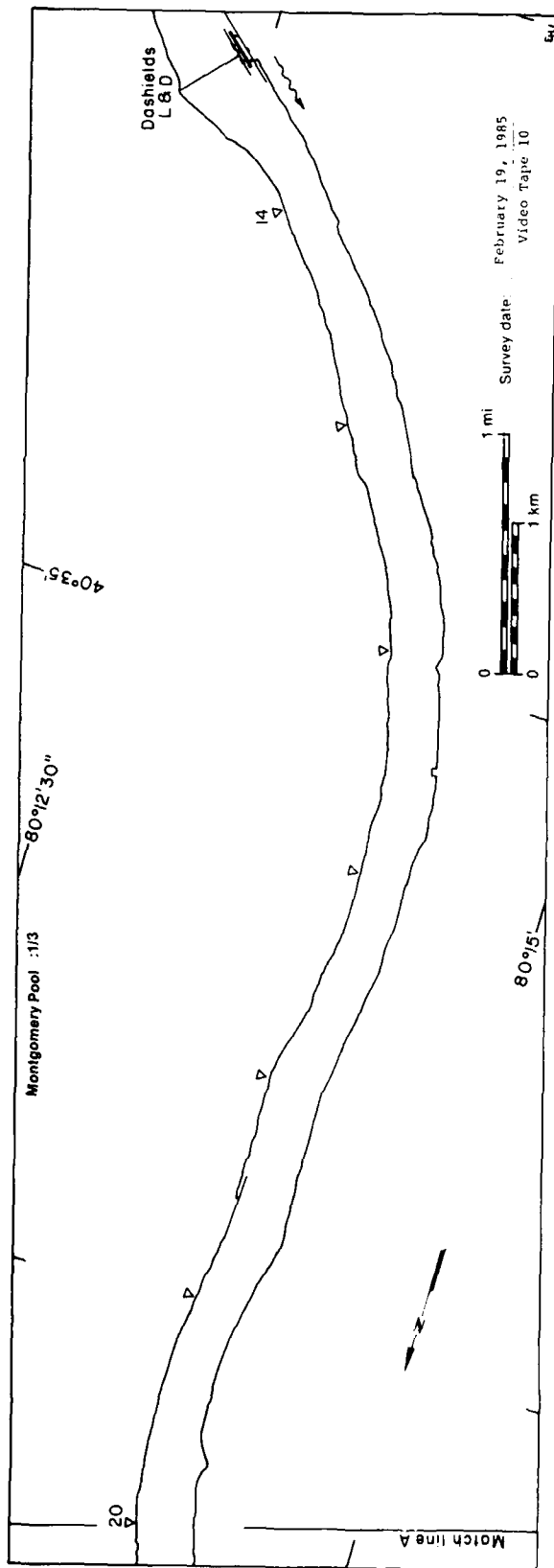
Total Area: $4.42 \times 10^6 \text{ km}^2$



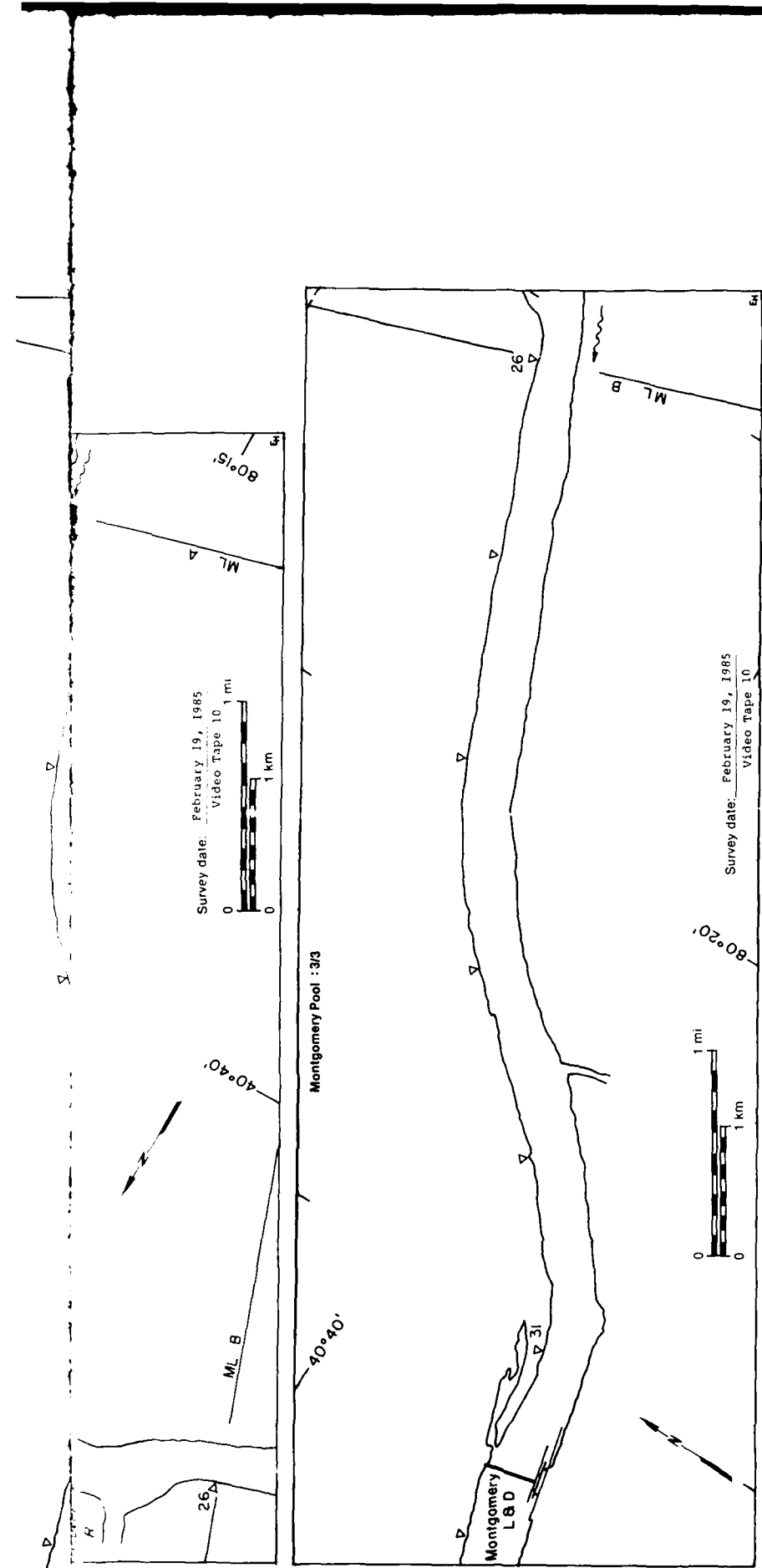


Dashiels Pool		Surface concentration (%)
MAP UNITS	Area (m ² x 10 ⁶)	
Open water	4.97	NA
Solid ice cover	--	NA
Solid ice cover with open-water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	--	--
Ice floes or frazil slush and pans	0.03	2
Total Area (m ² x 10 ⁶)		5.00

19 February 1985









Montgomery Pool :3/3



Montgomery Pool

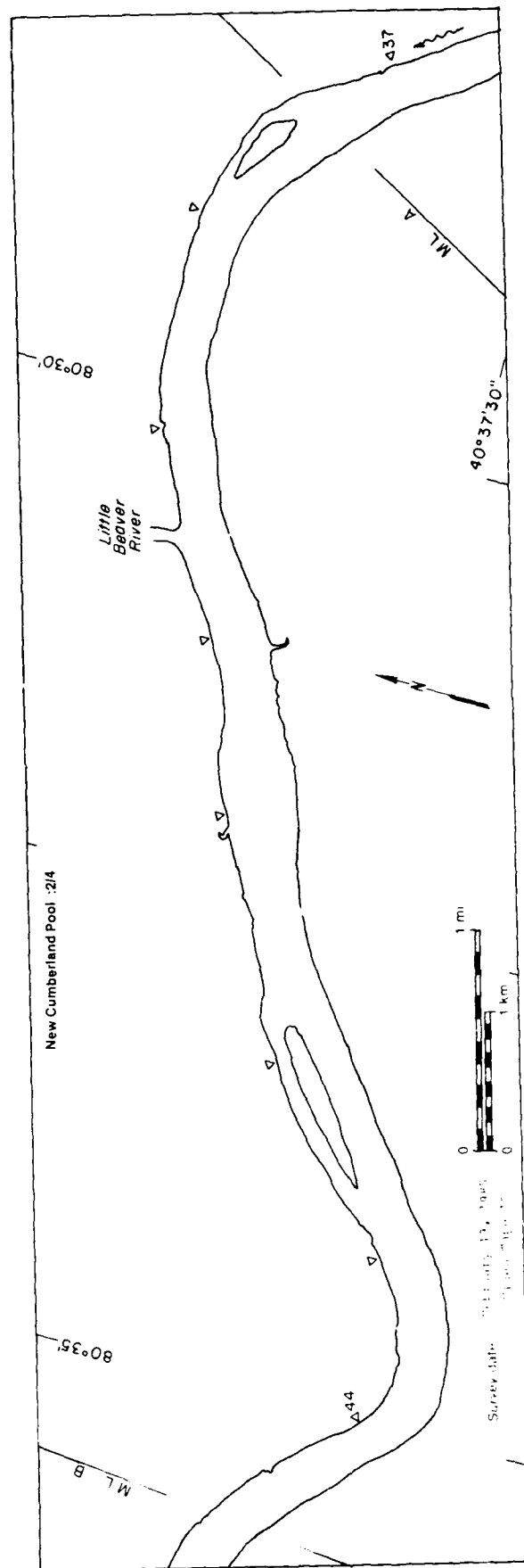
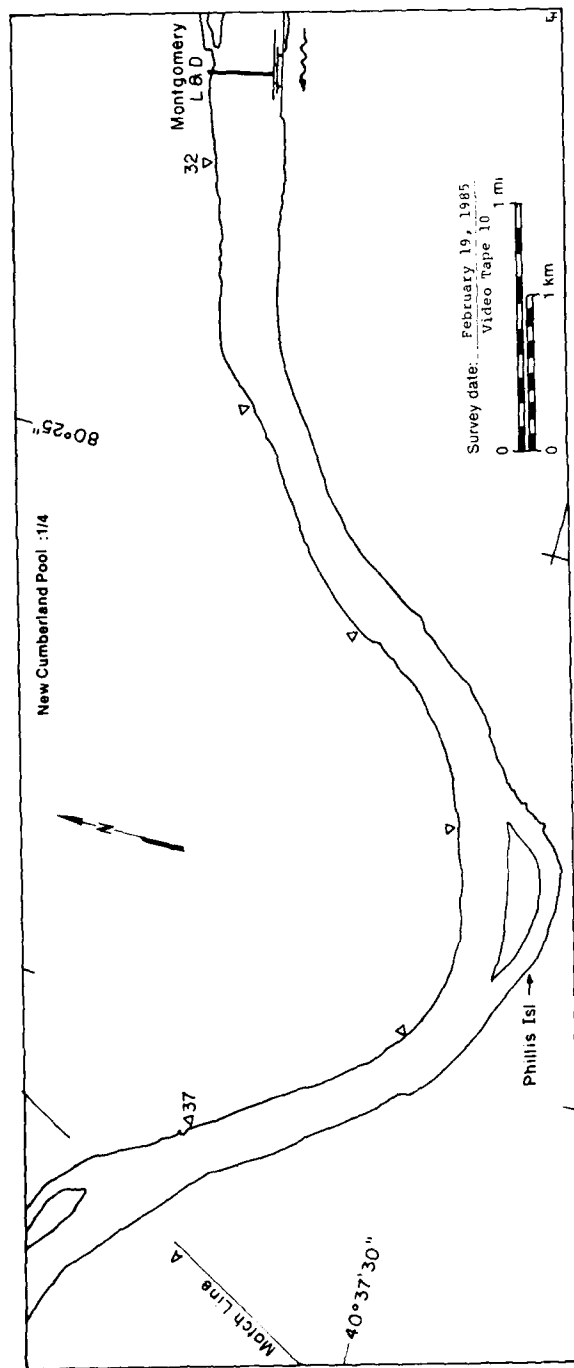
MAP UNITS

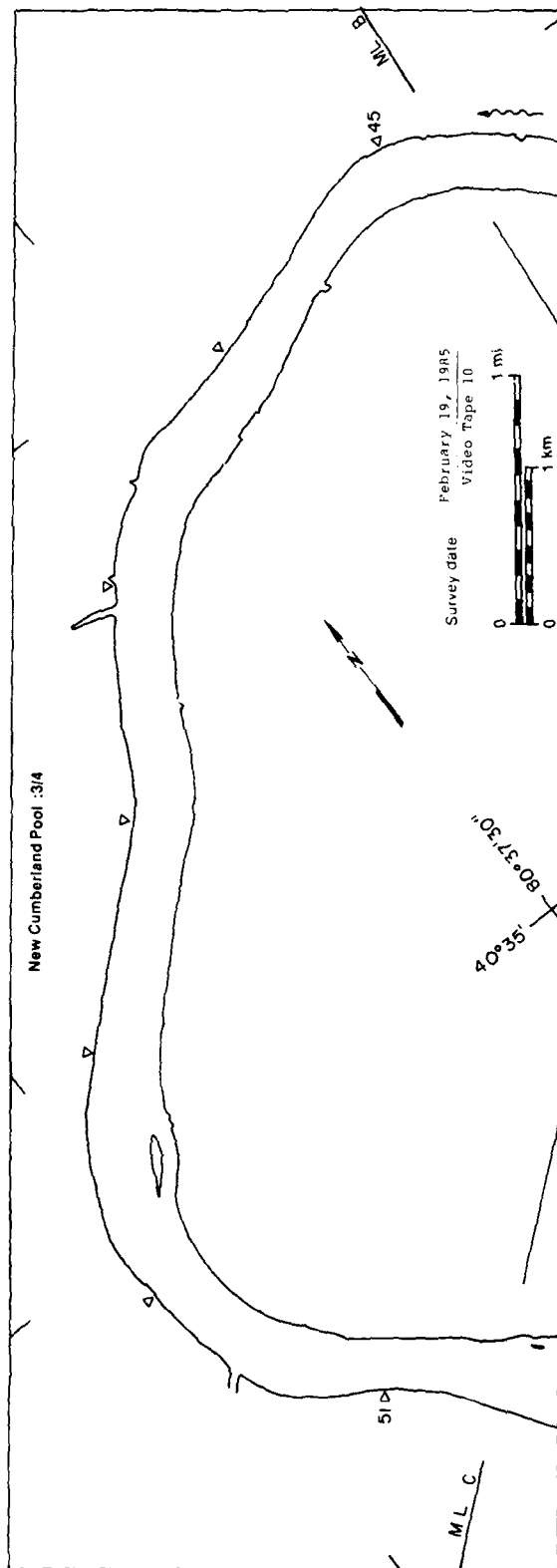
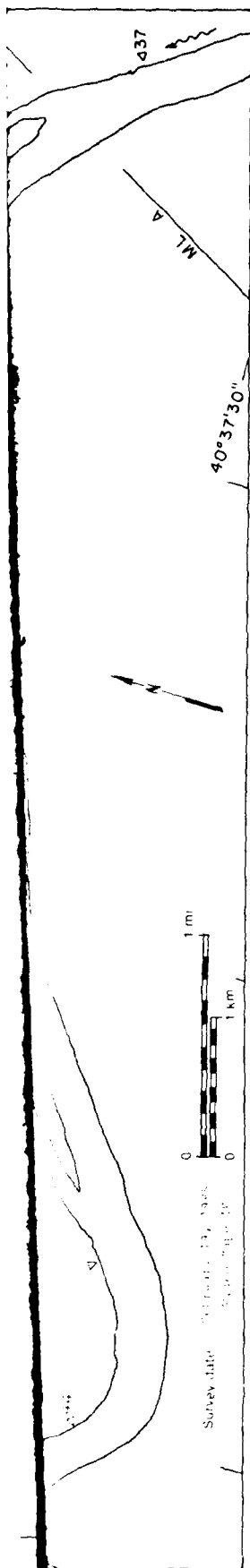
-  Open water
-  Solid ice cover
-  Solid ice cover with open-water areas
-  Fragmented ice cover
-  Fragmented ice cover with open-water areas
-  Ice floes or frazil slush and pans

Area (mi ²)	Surface concentration (%)
11.27	NA
--	NA
--	--
--	NA
--	--
--	--
11.27	

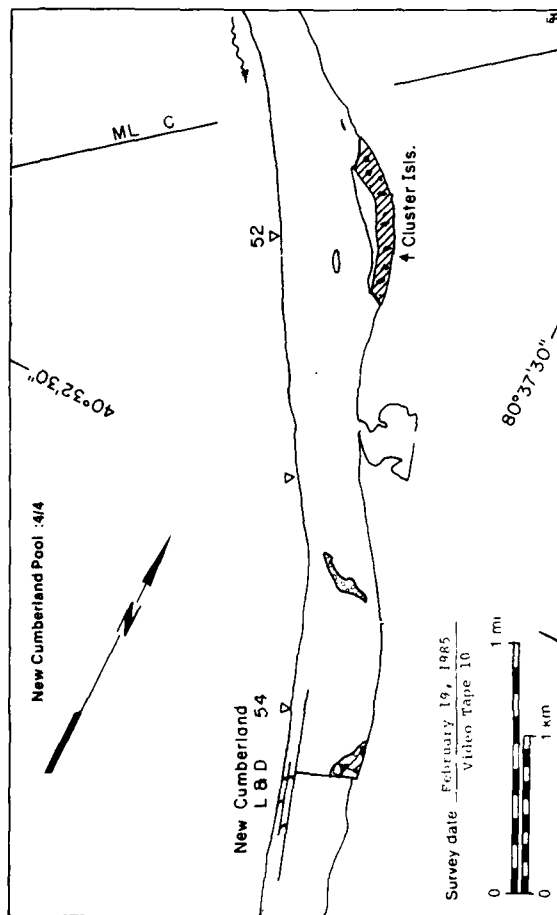
Total Area (m² x 10⁶)

19 February 1985



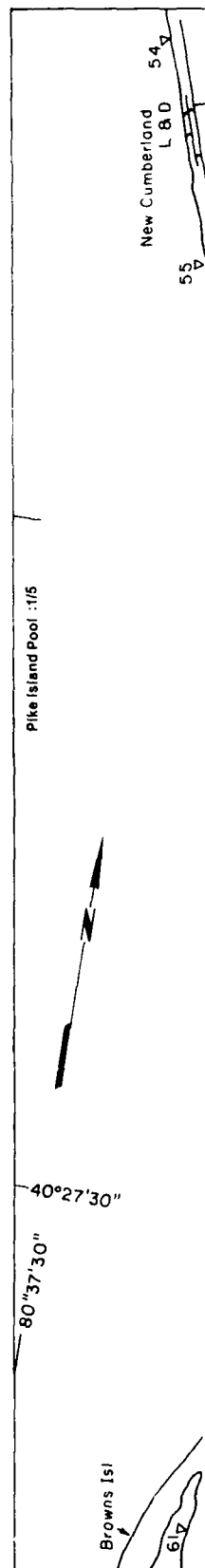


19 February 1985

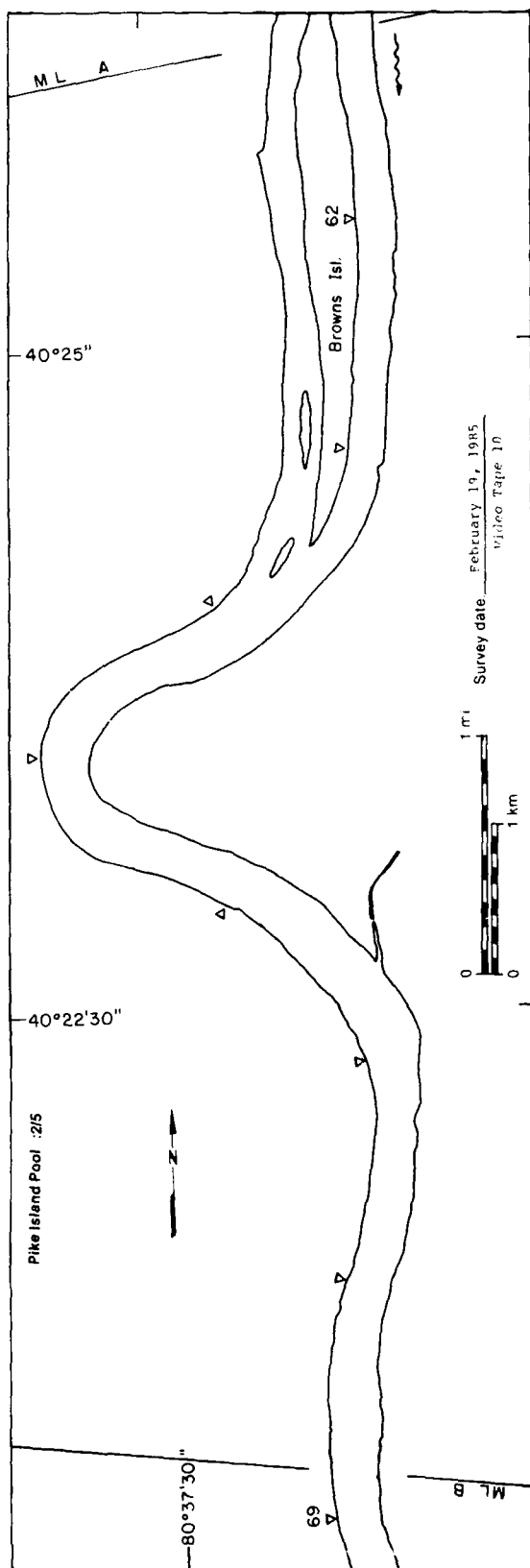
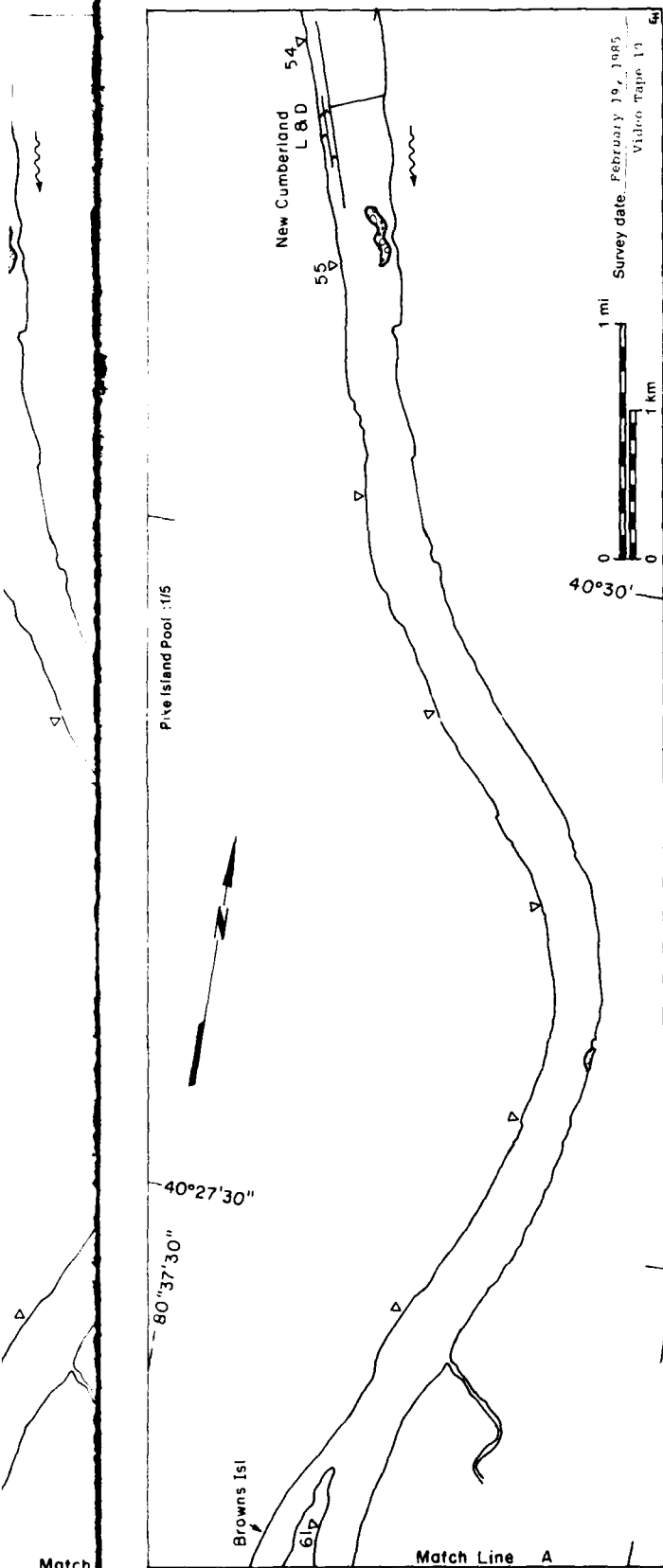


New Cumberland Pool

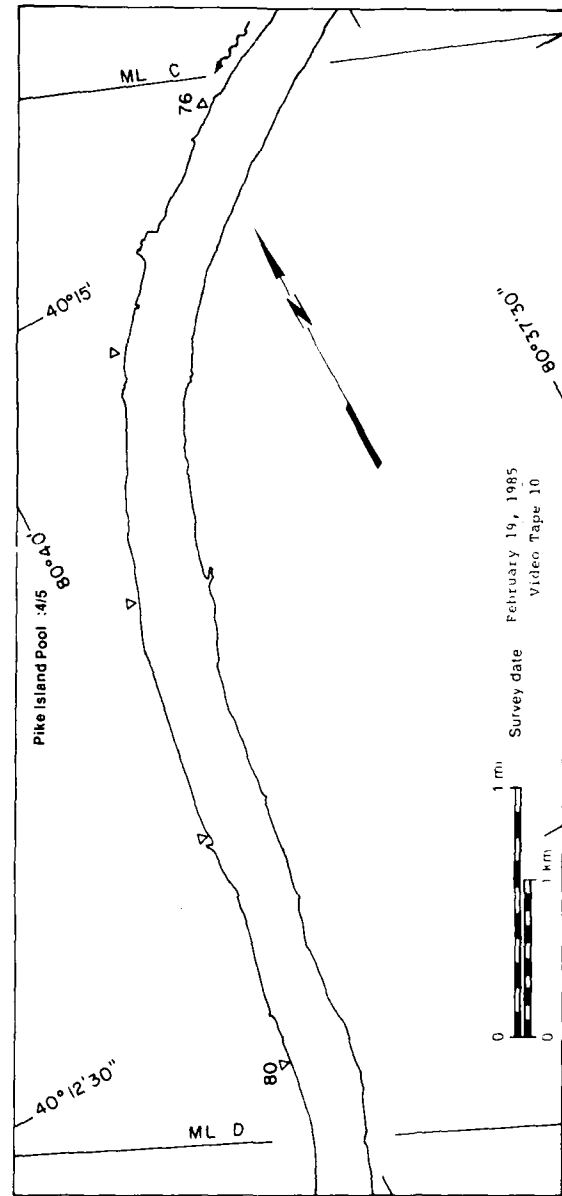
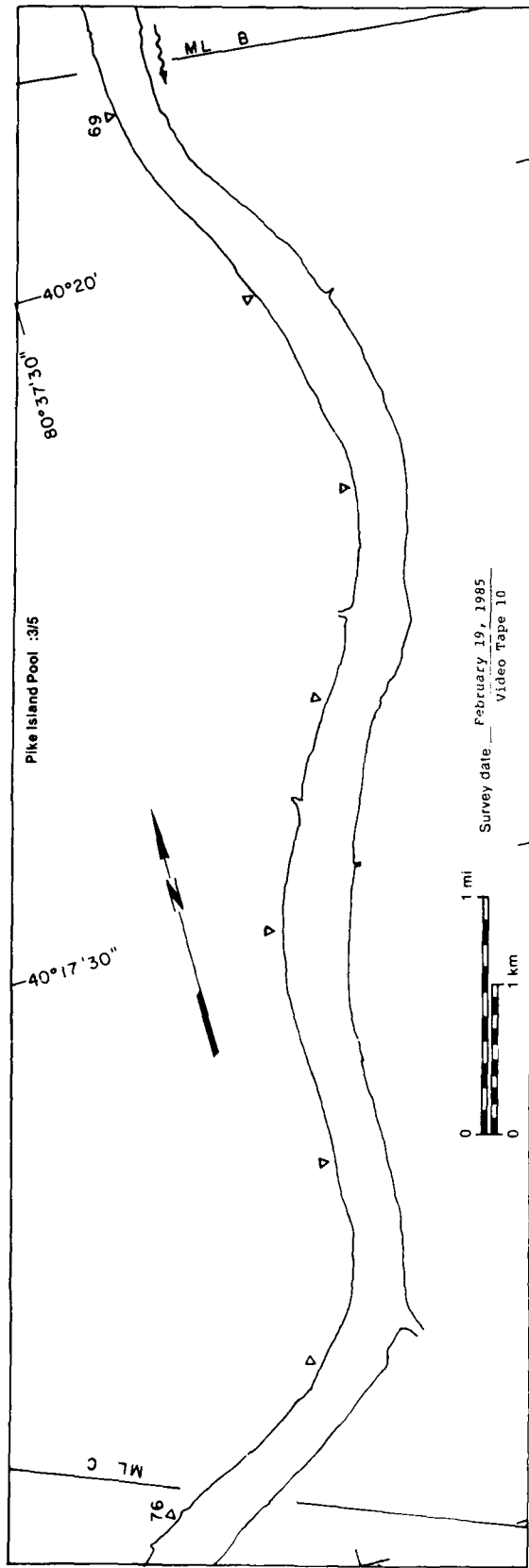
MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	14.69	NA
Solid ice cover	--	NA
Solid ice cover with open-water areas	0.12	90
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	0.04	90
Ice floes or frazil slush and pans	0.02	1
Total Area (m ² x 10 ⁶)	14.87	

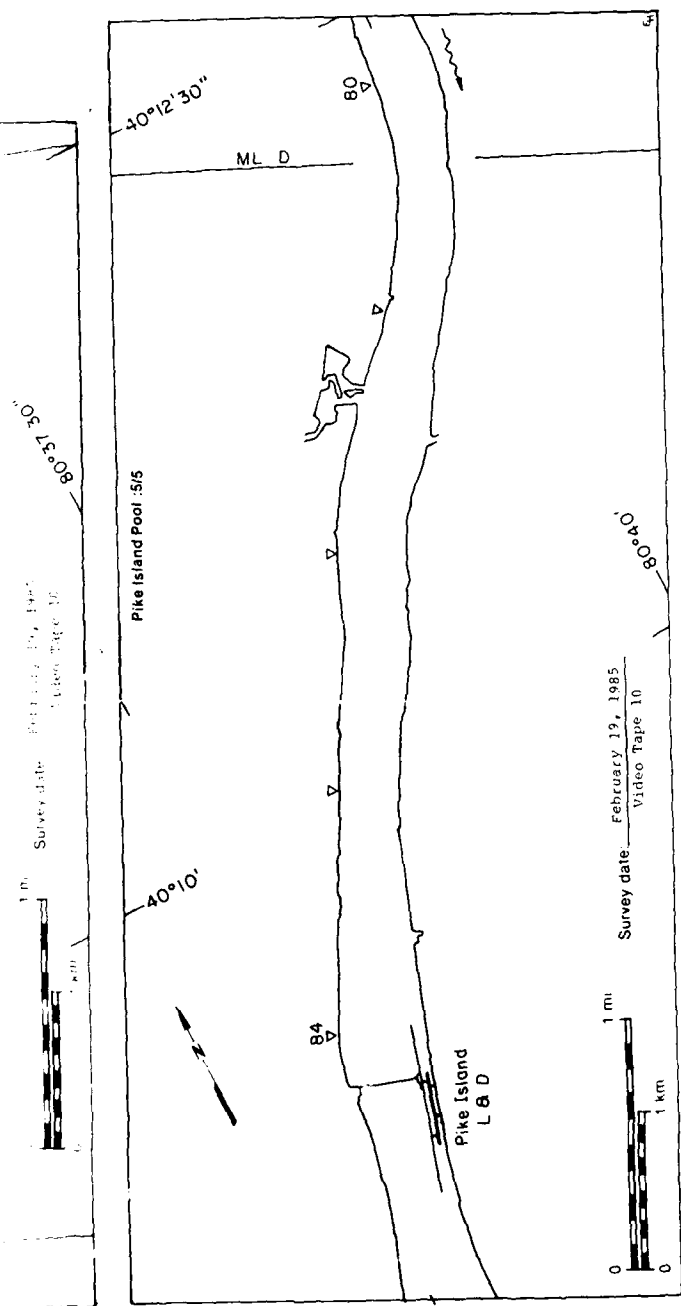


New Cumberland L B D 54



19 February 1985

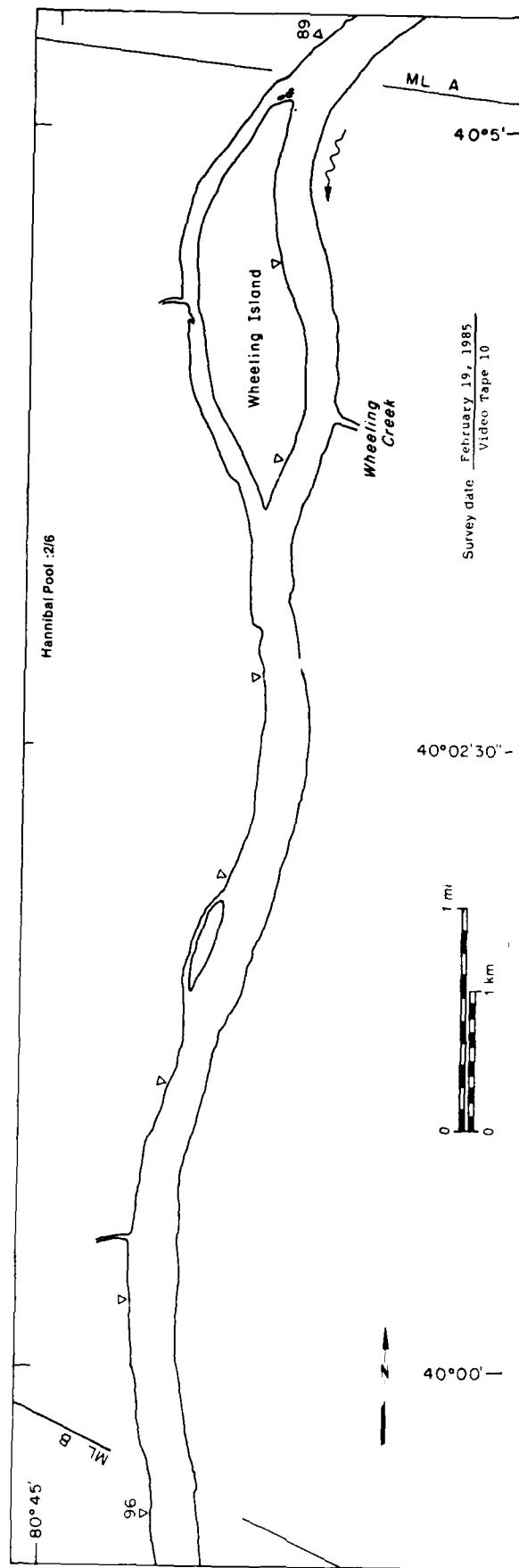
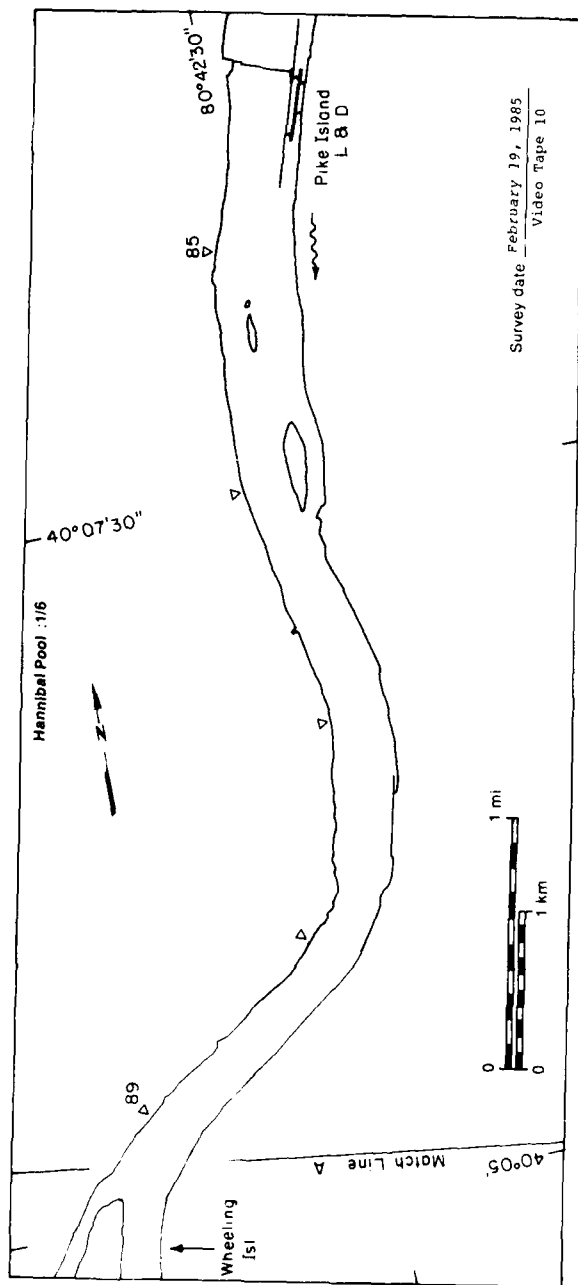


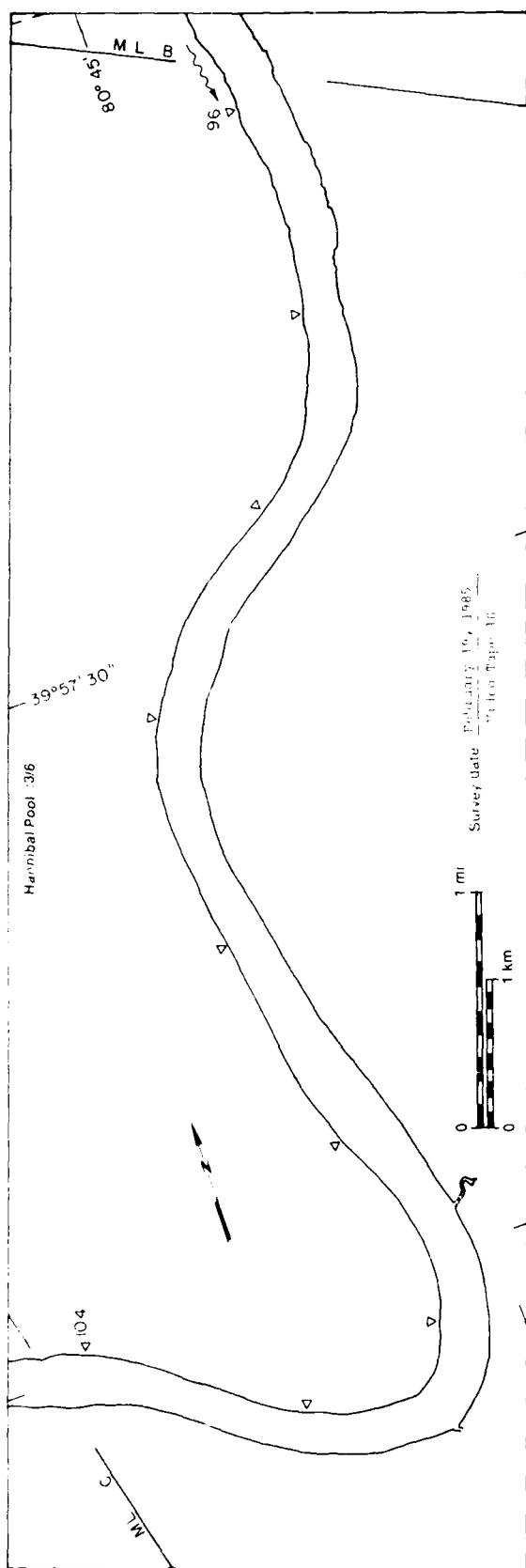


Pike Island Pool

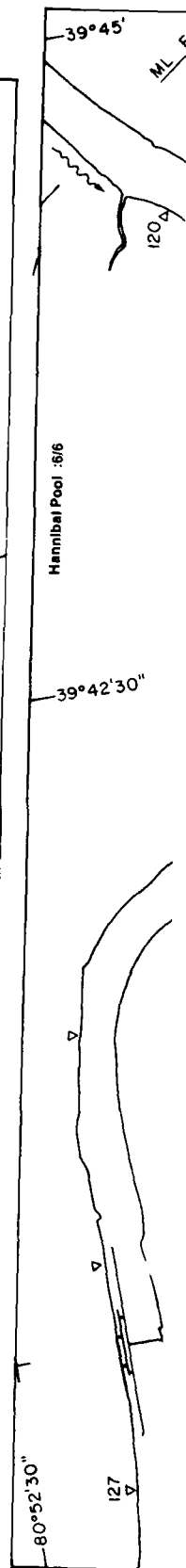
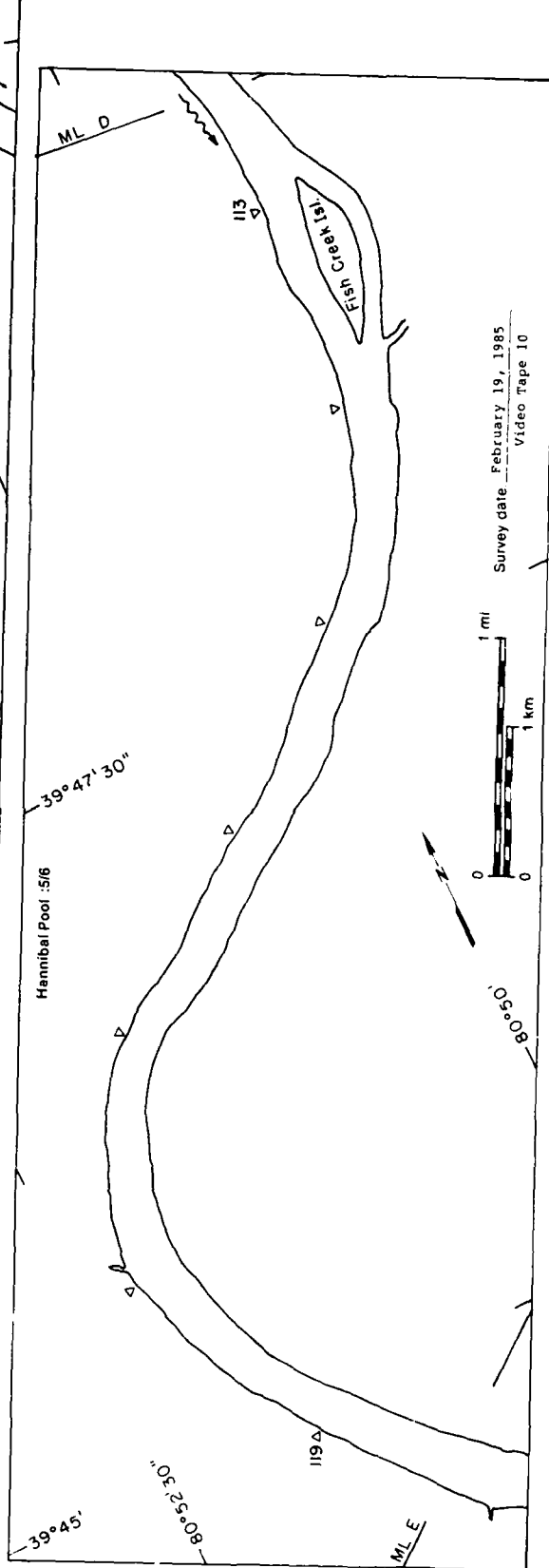
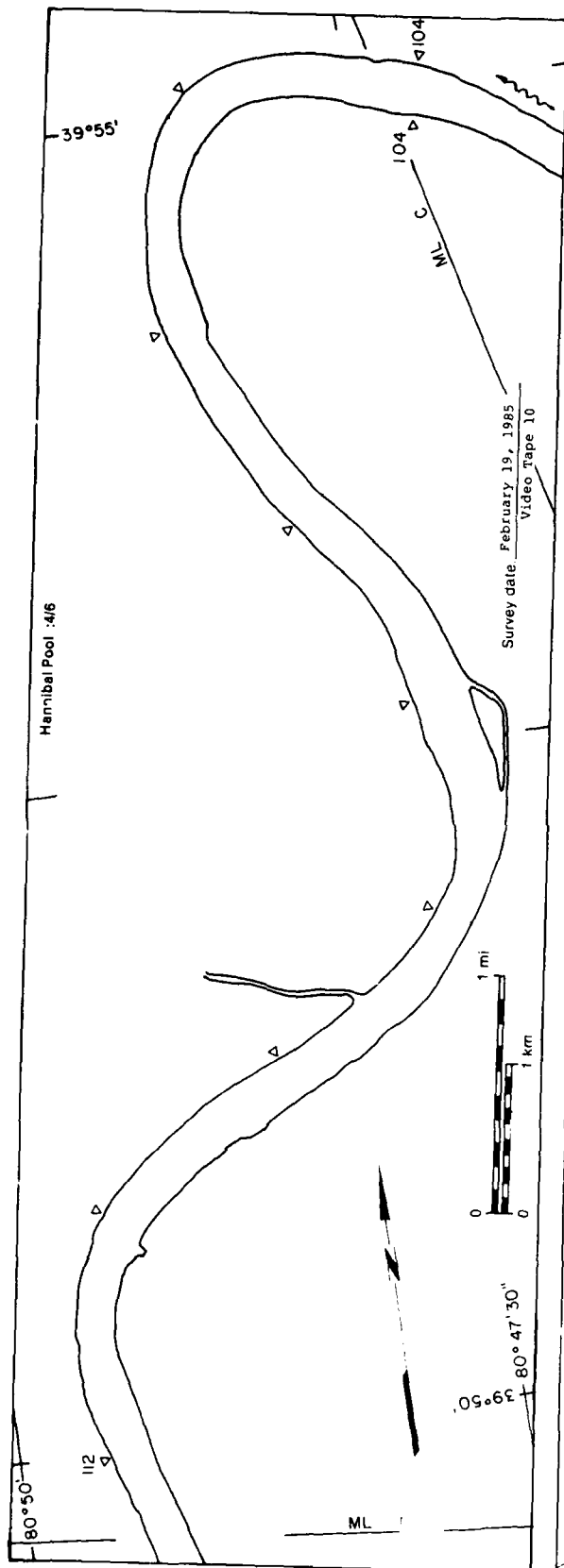
MAP UNITS	Area δ_1 ($m^2 \times 10^6$)	Surface concentration (%)
Open water	18.89	NA
Solid ice cover	—	NA
Solid ice cover with open-water areas	—	—
Fragmented ice cover	—	NA
Fragmented ice cover with open-water areas	—	—
Ice floes or frazil slush and pans	0.03	?
Total Area ($m^2 \times 10^6$)	18.92	

19 February 1985

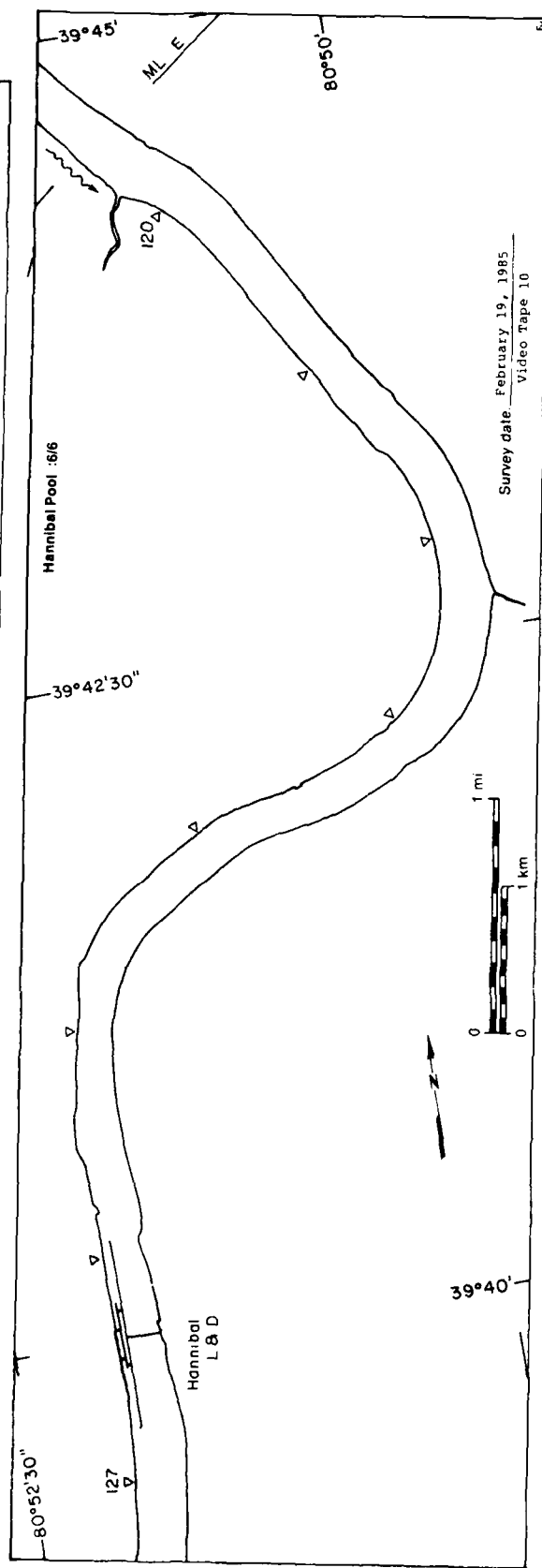




19 February 1985



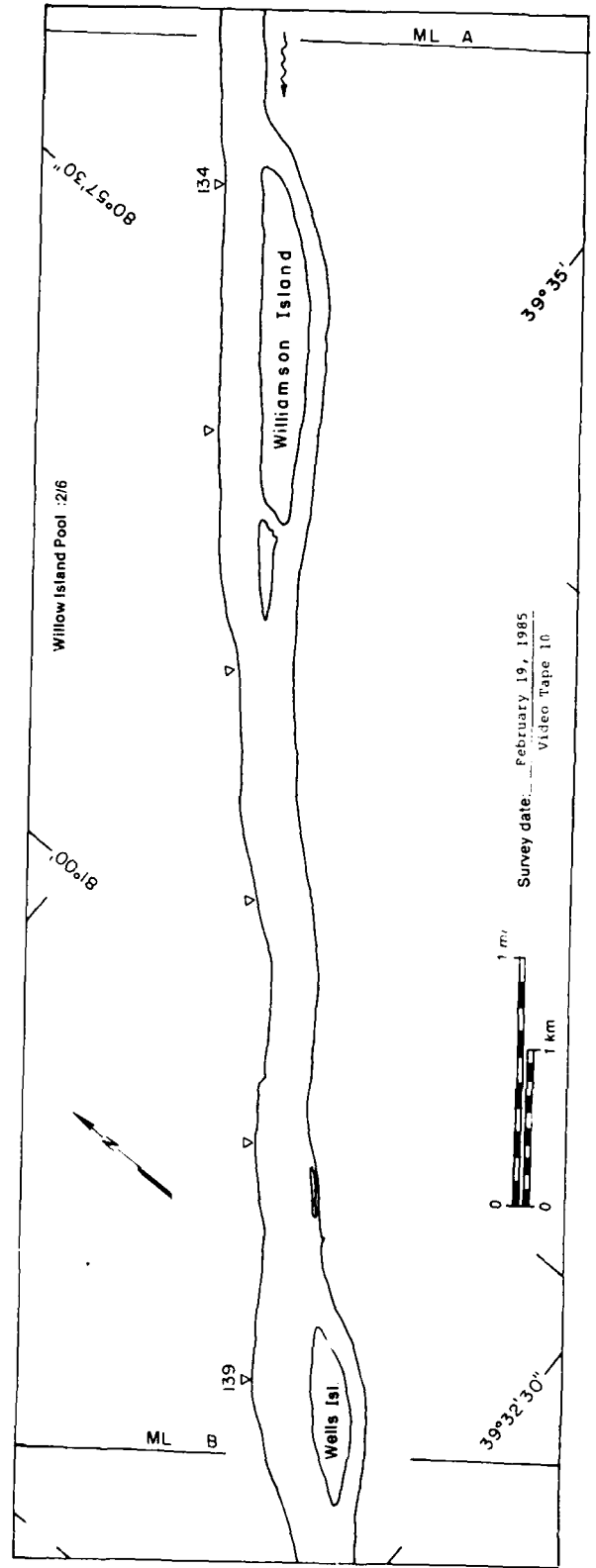
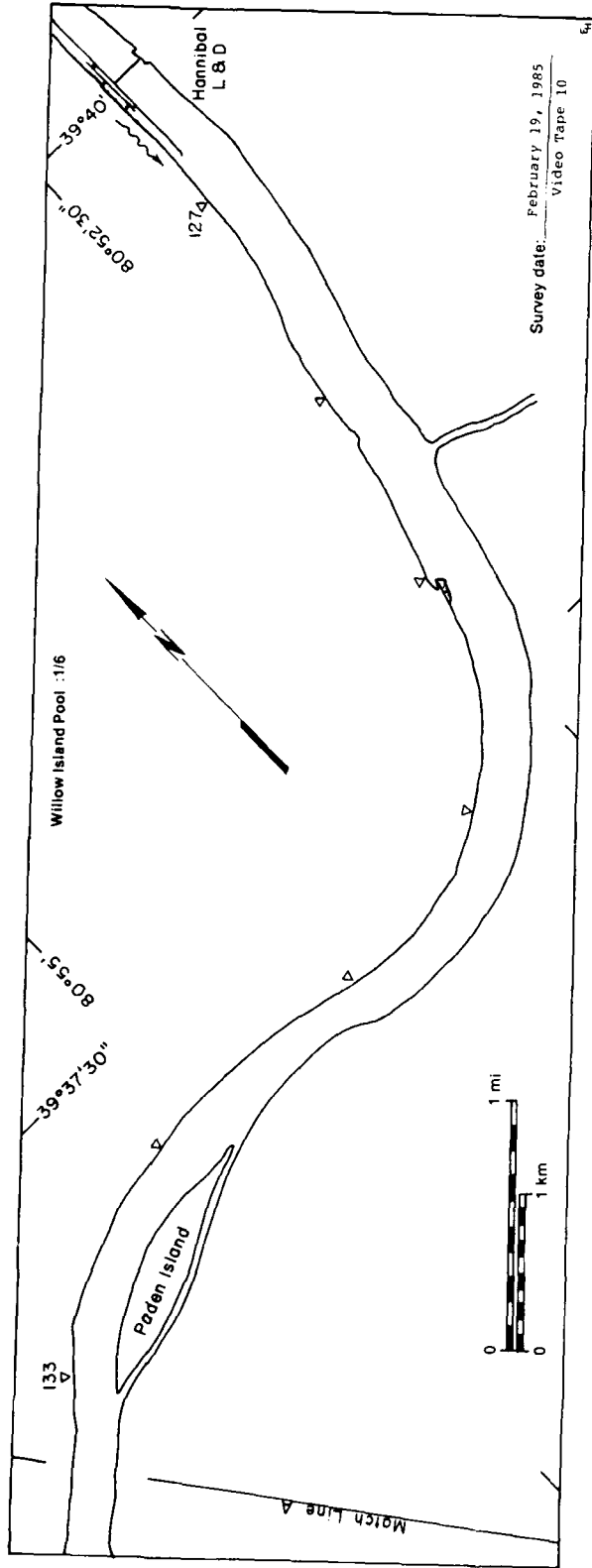
Survey date February 19, 1985
Video Tape 10

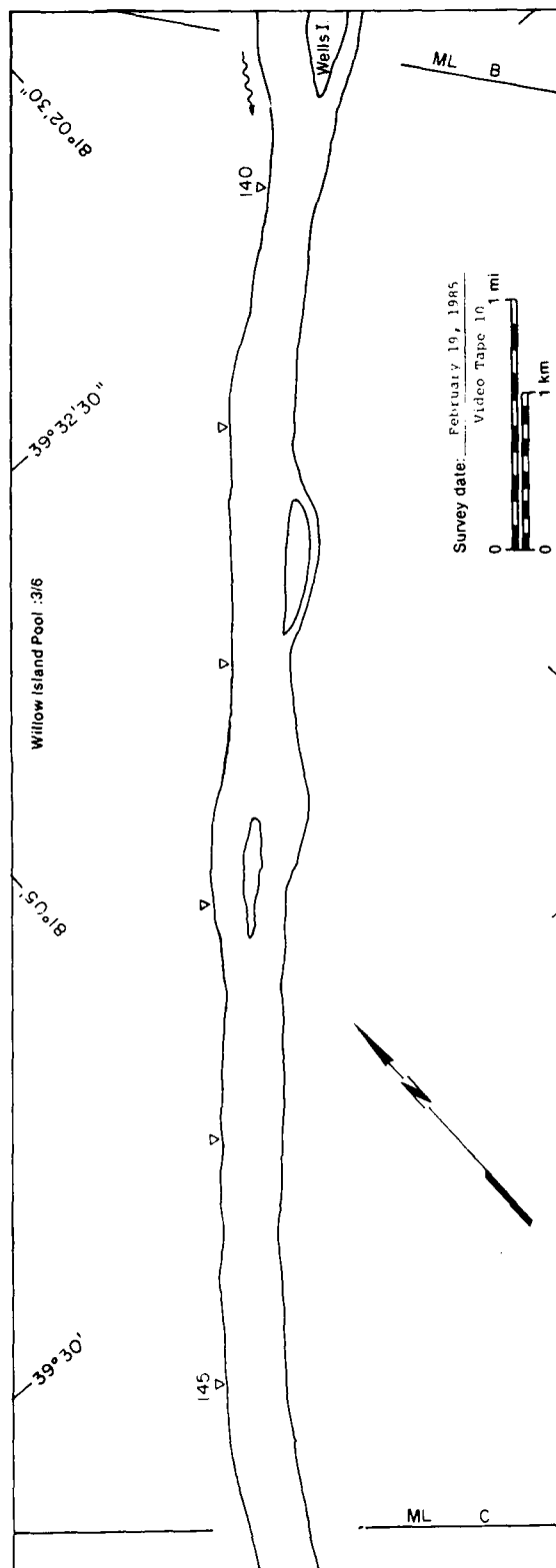
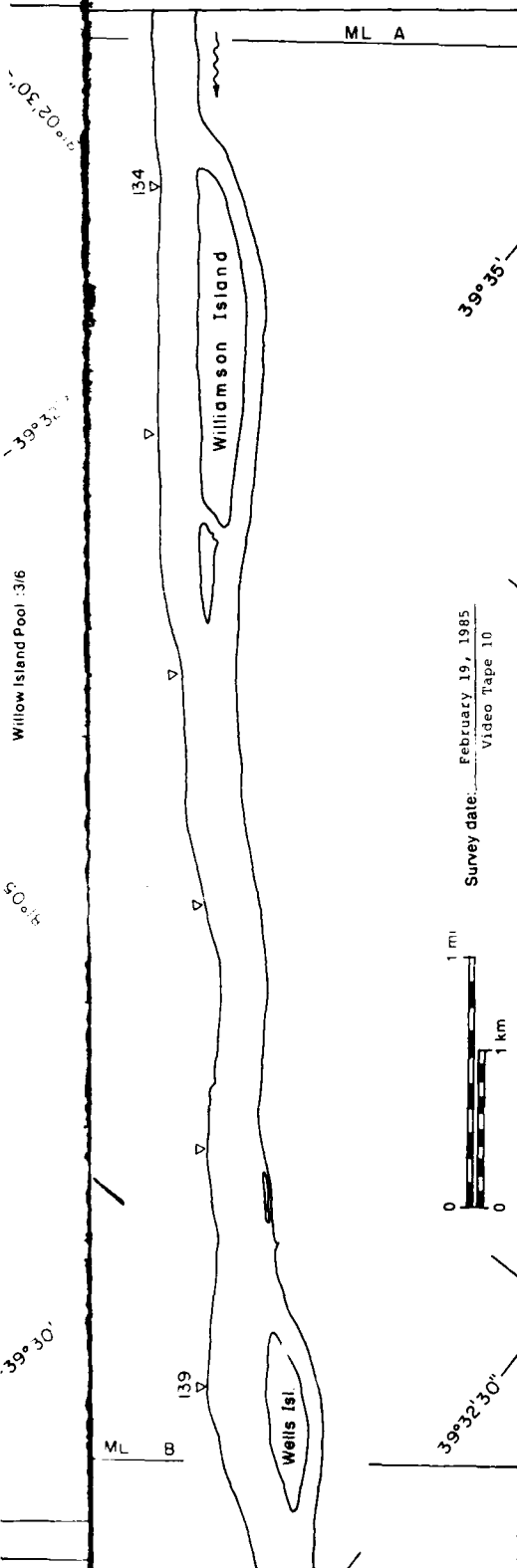


Survey date February 19, 1985
Video Tape 10

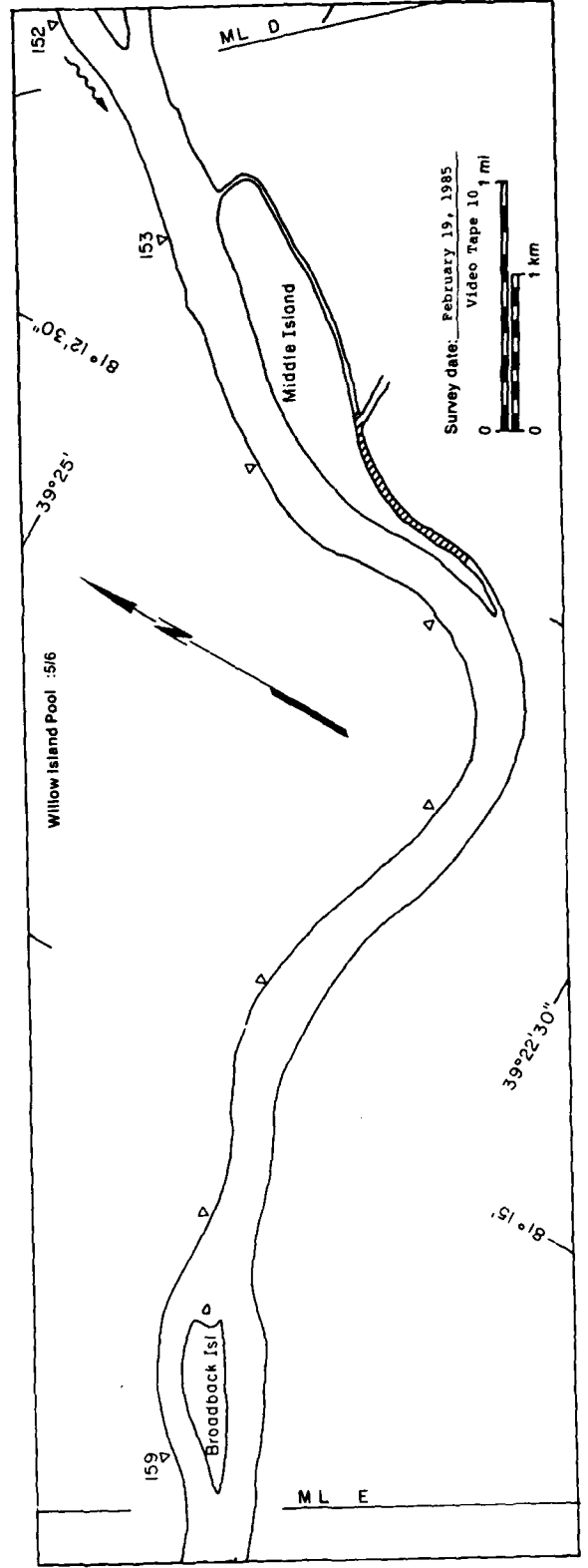
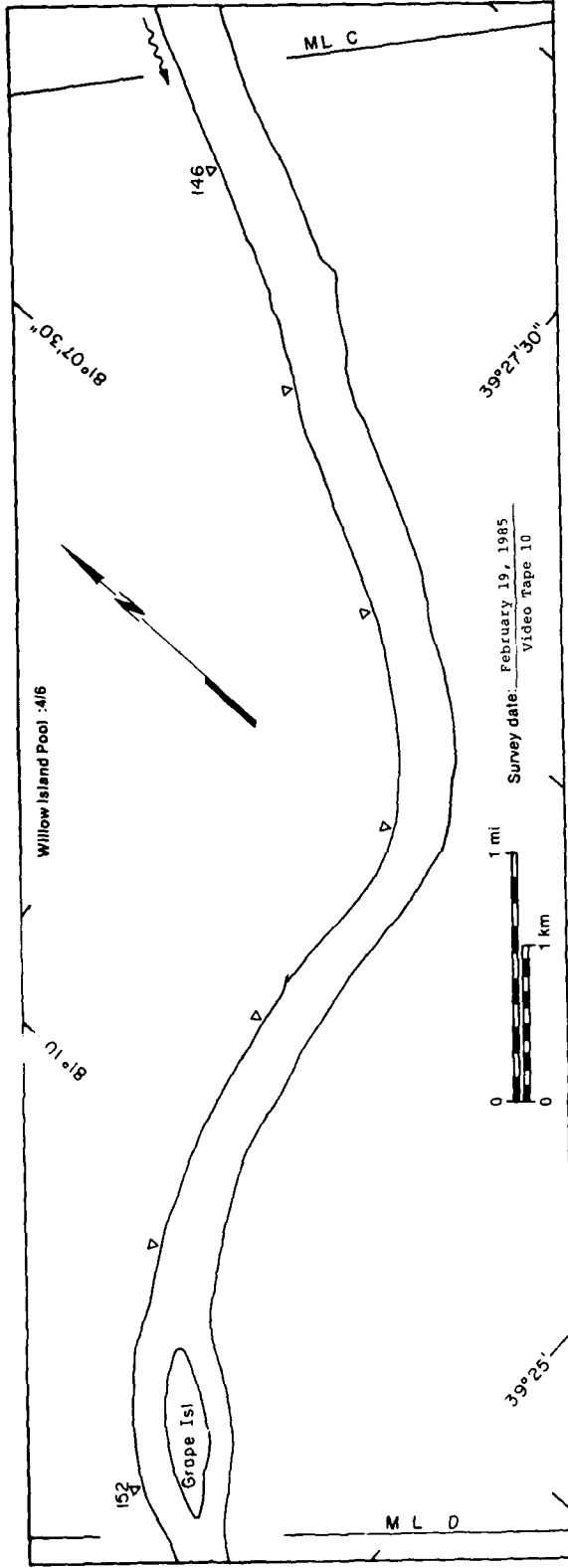
Hannibal Pool		Area	Surface
MAS UNITS		(m ² x 10 ⁶)	concentration (%)
	Open water	22.46	NA
	Solid ice cover	---	NA
	Solid ice cover with open water areas	---	---
	Fragmented ice cover	---	NA
	Fragmented ice cover with open water areas	---	---
	Ice floes or hazel slush and bans	---	---
Total Area (m ² x 10 ⁶)		22.46	

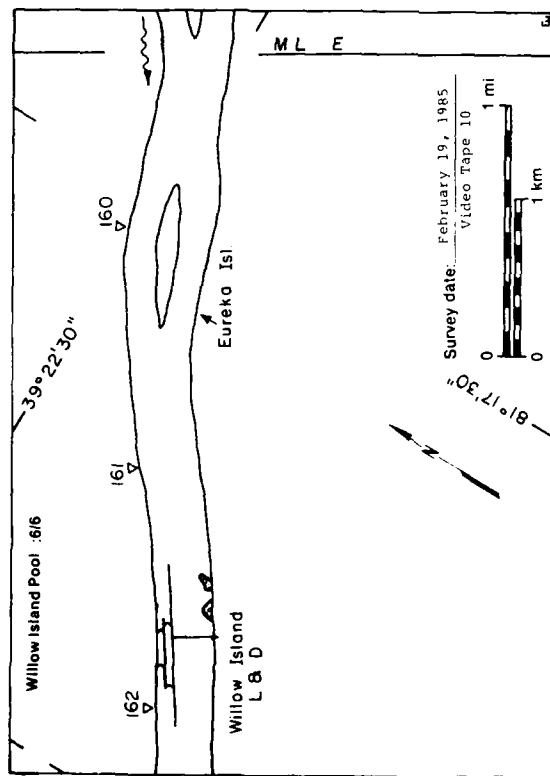
19 February 1985



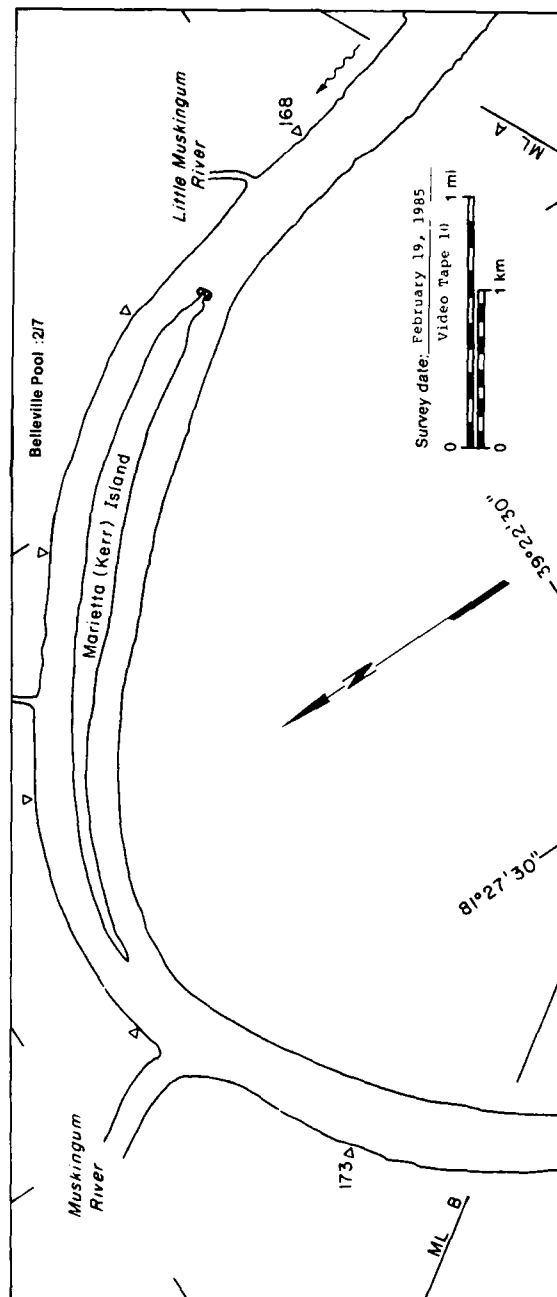
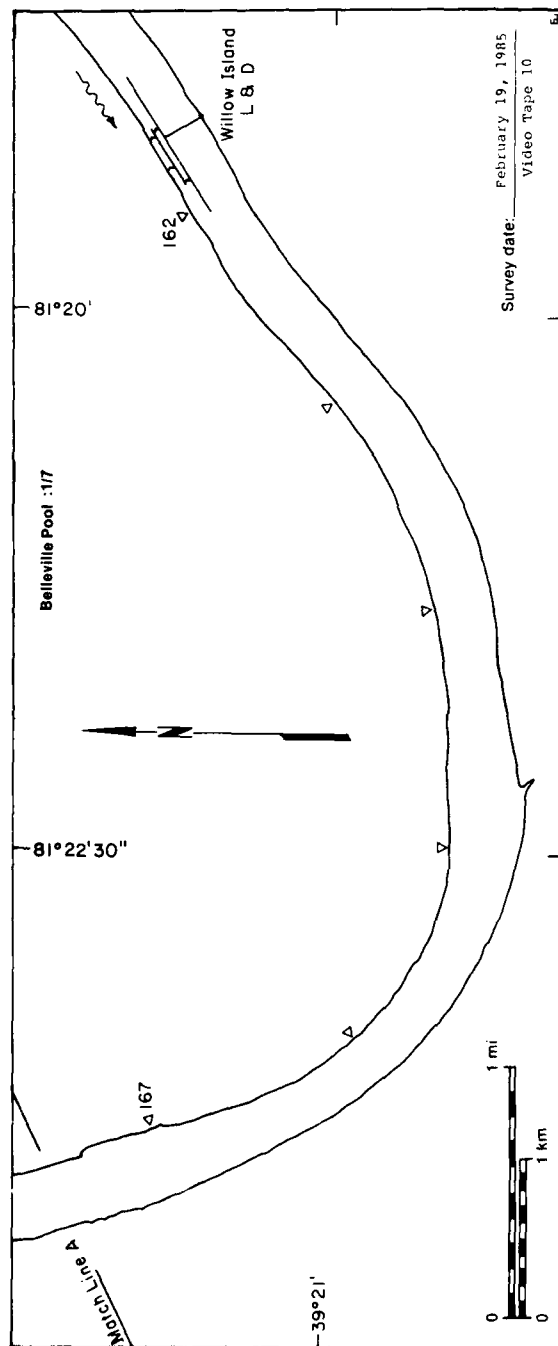


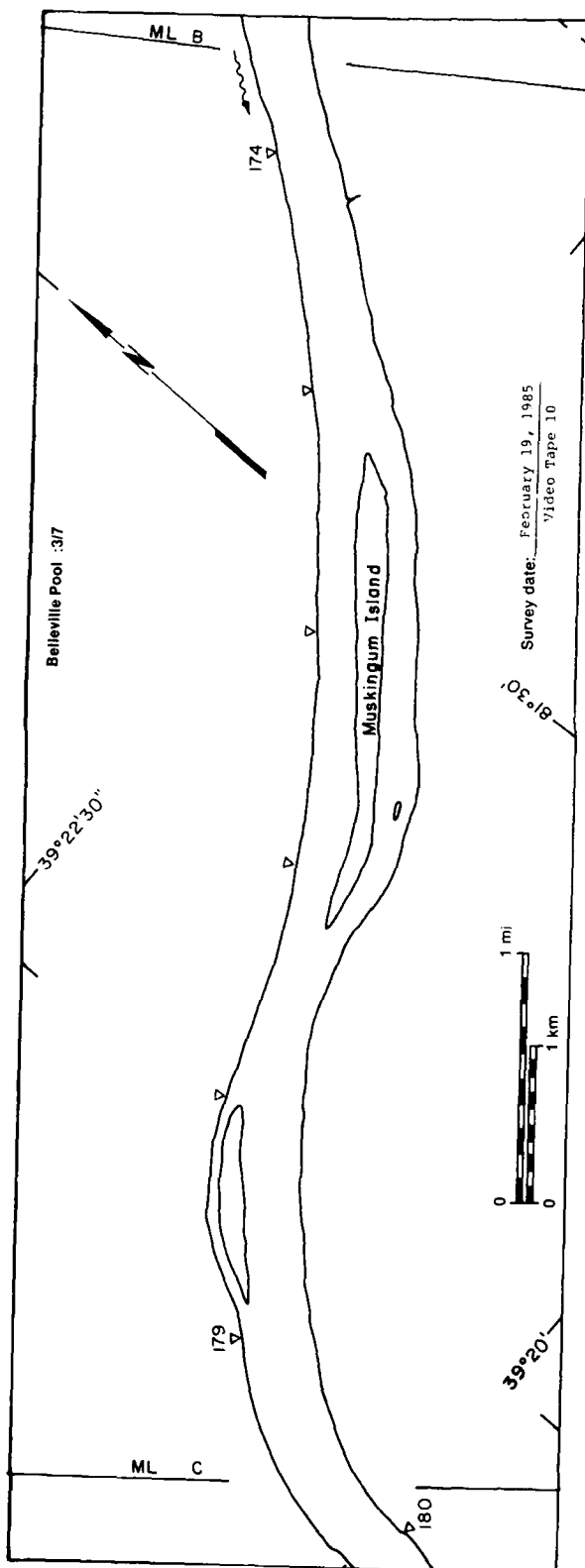
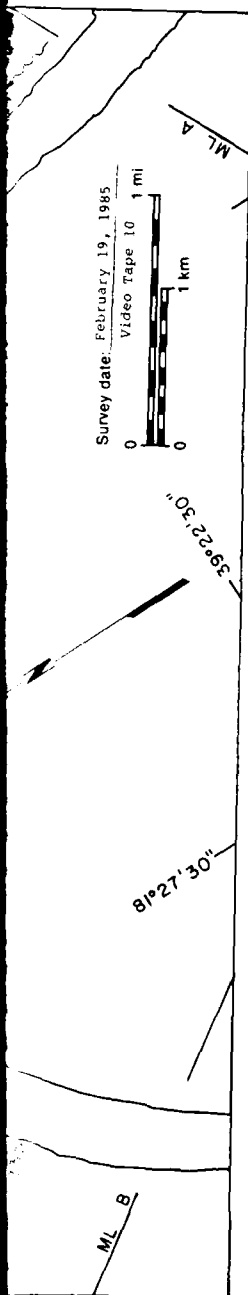
19 February 1985



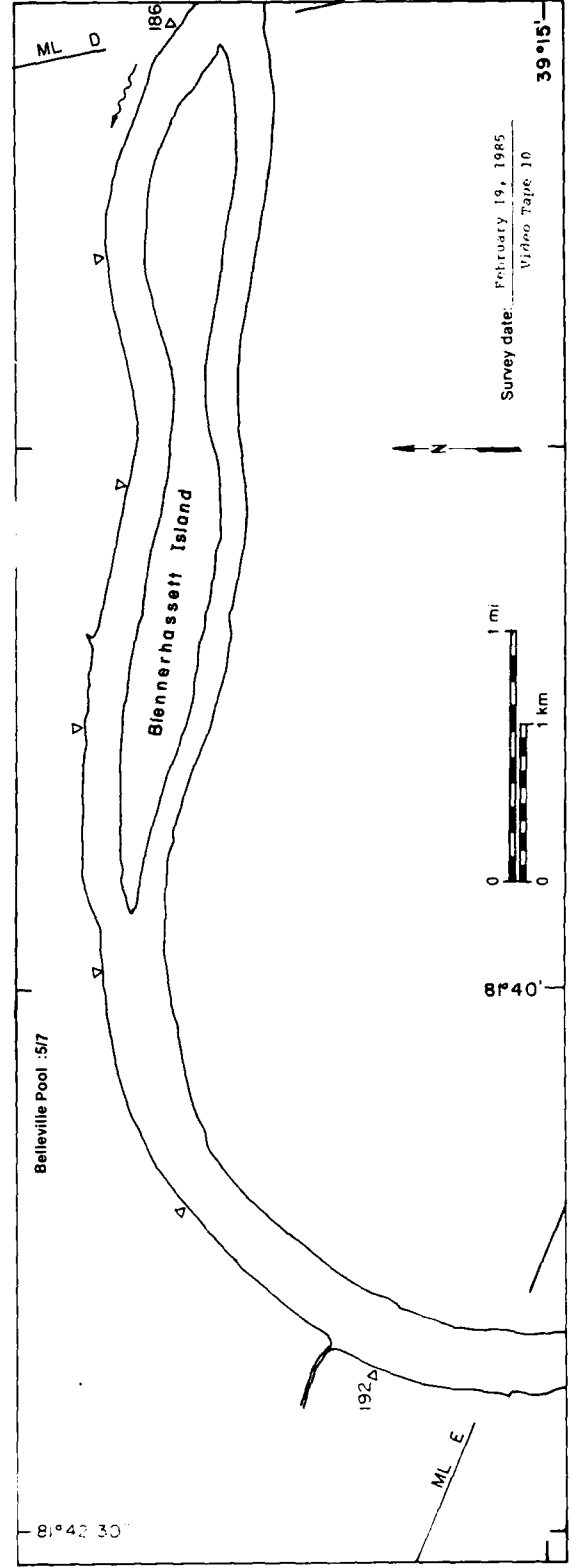
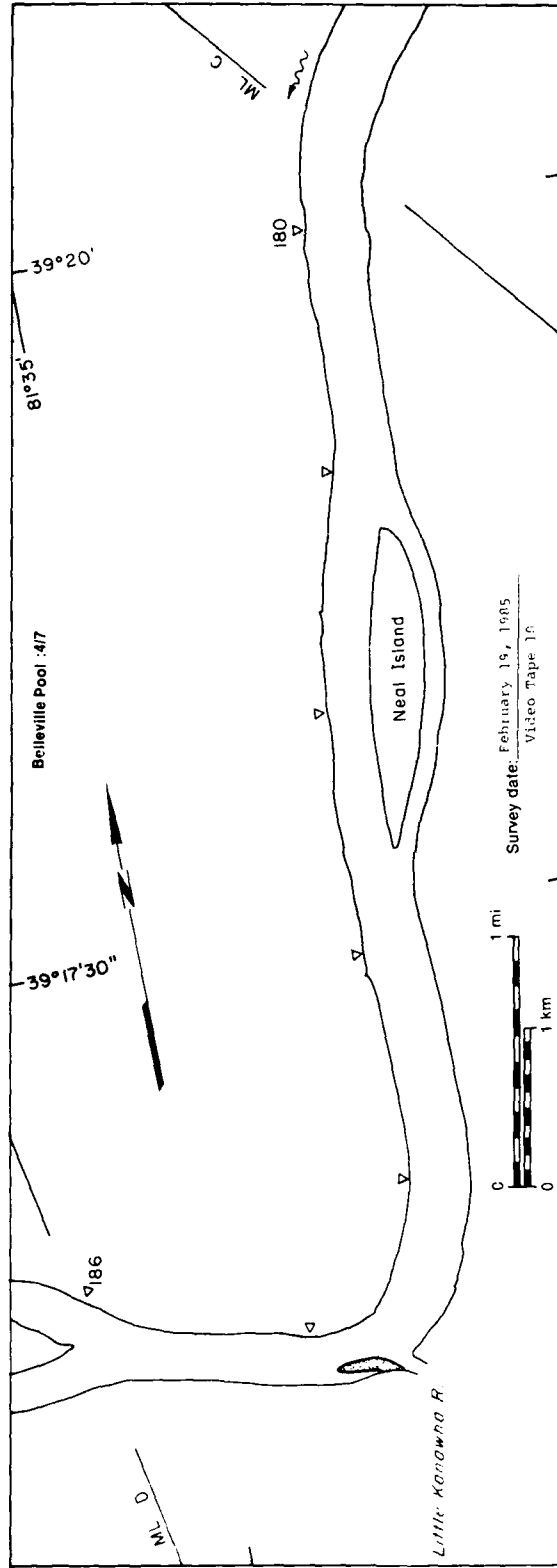


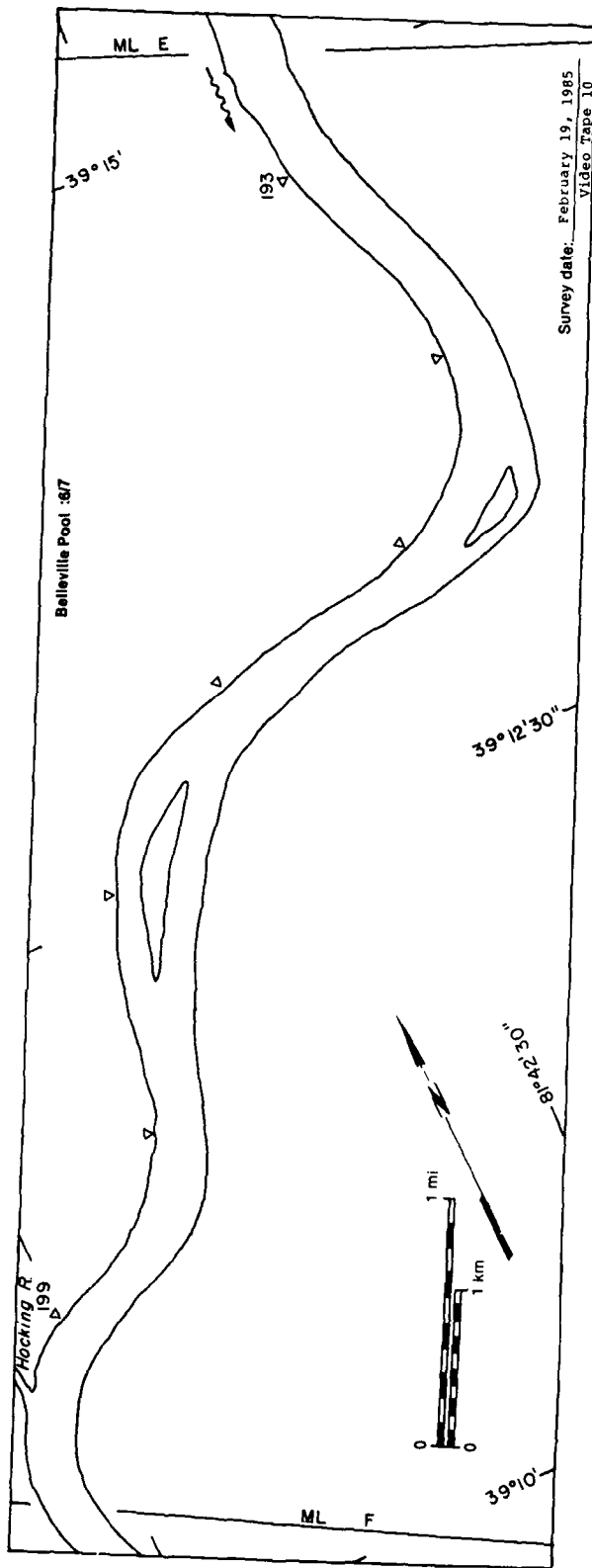
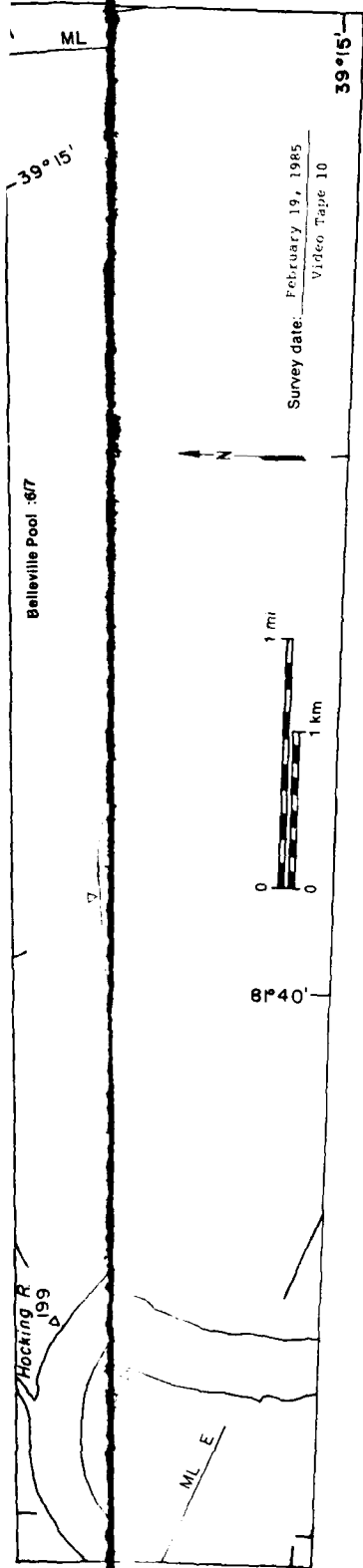
19 February 1985



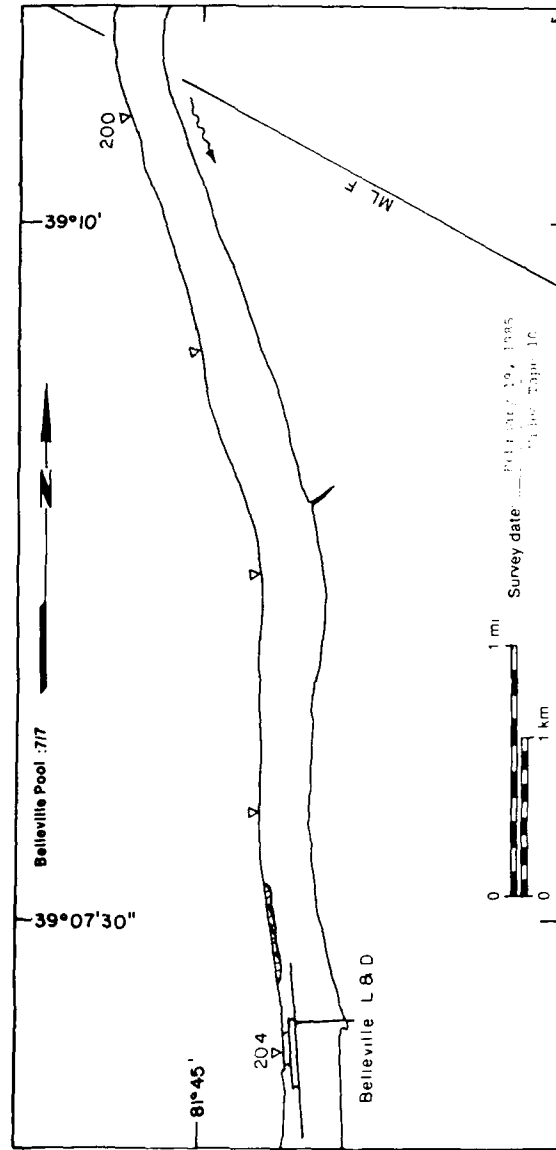


19 February 1985





19 February 1985



Belleville Pool

MAP UNITS

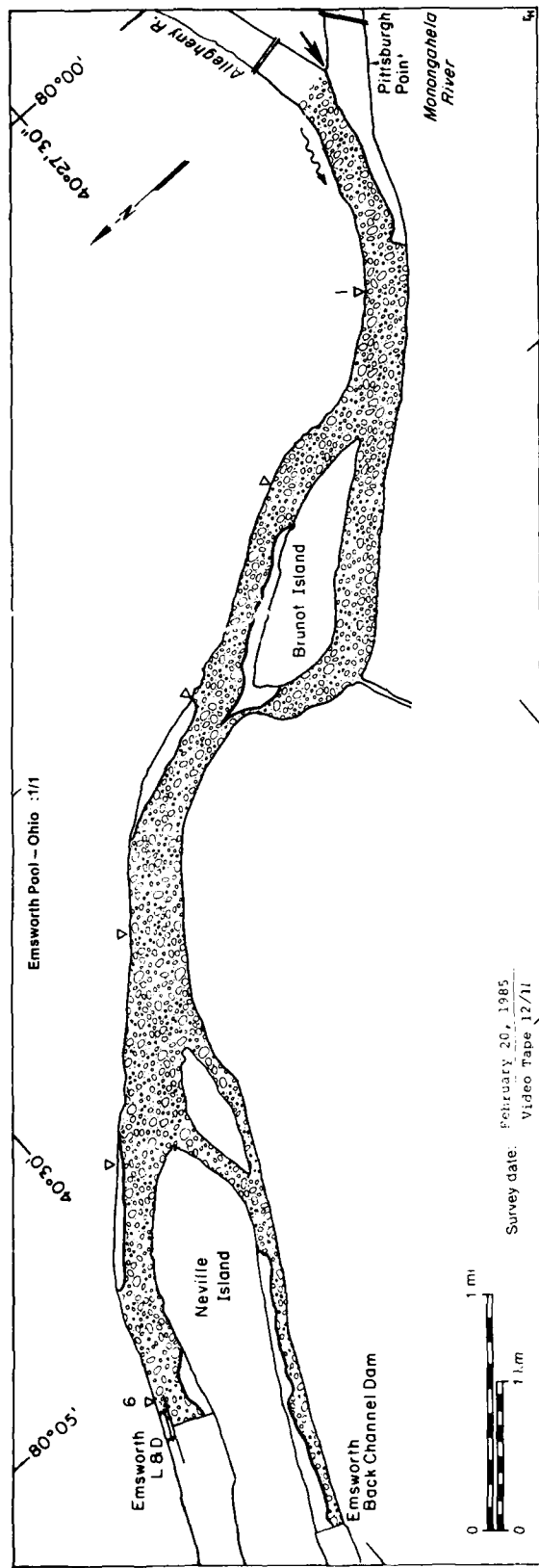
	Open water
	Solid ice cover
	Solid ice cover with open water areas
	Fragmented ice cover
	Fragmented ice cover with open water areas
	Ice slush and leads

Area of ice cover (km² x 10³)

0.00	NA
0.01	NA
0.02	NA
0.03	NA
0.04	96
0.05	96

Total Area of Ice Cover (km² x 10³)

20 February 1985



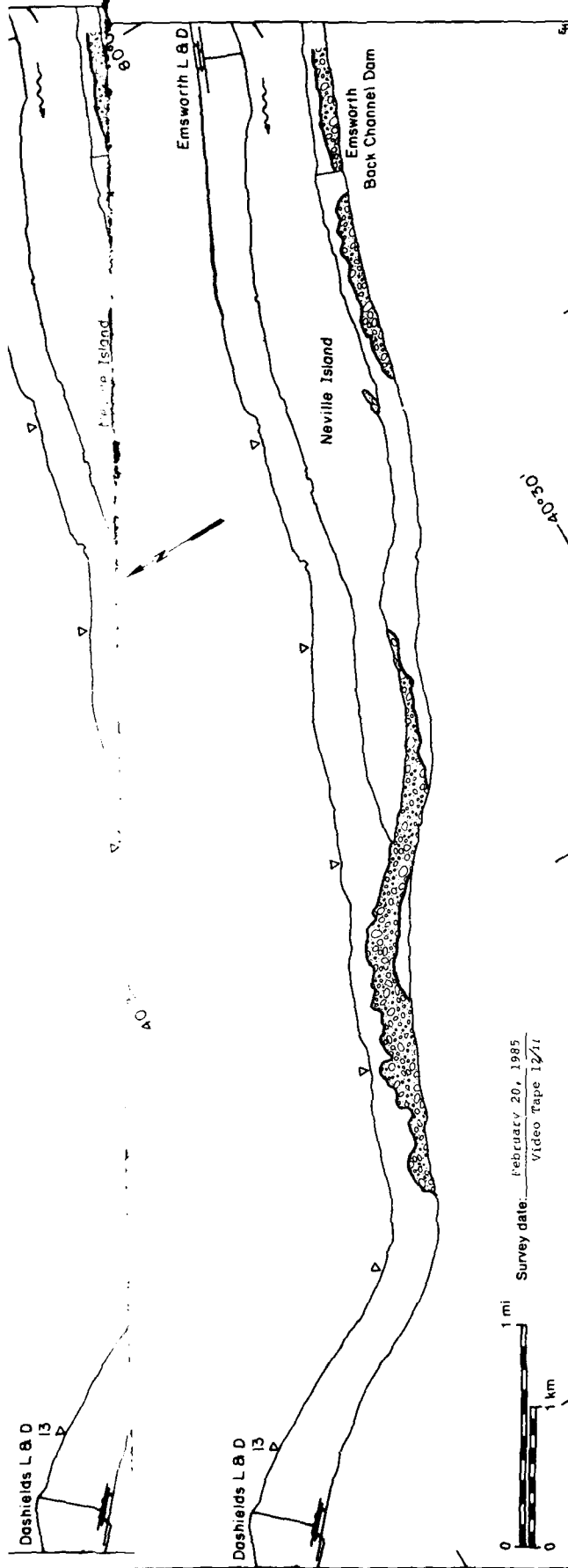
Survey date: February 20, 1985
Video Tape 12/11

Emsworth Pool - Ohio

MAP UNITS		Surface concentration (%)
	Open water	0.69
	Solid ice cover	NA
	Solid ice cover with open water areas	NA
	Fragmented ice cover	---
	Fragmented ice cover with open water areas	---
	Ice floes or frazil slush and pans	5
Total Area (m ² x 10 ⁶)		4.49

Dashields Pool :1/1

Emsworth L&D



Doshields Pool

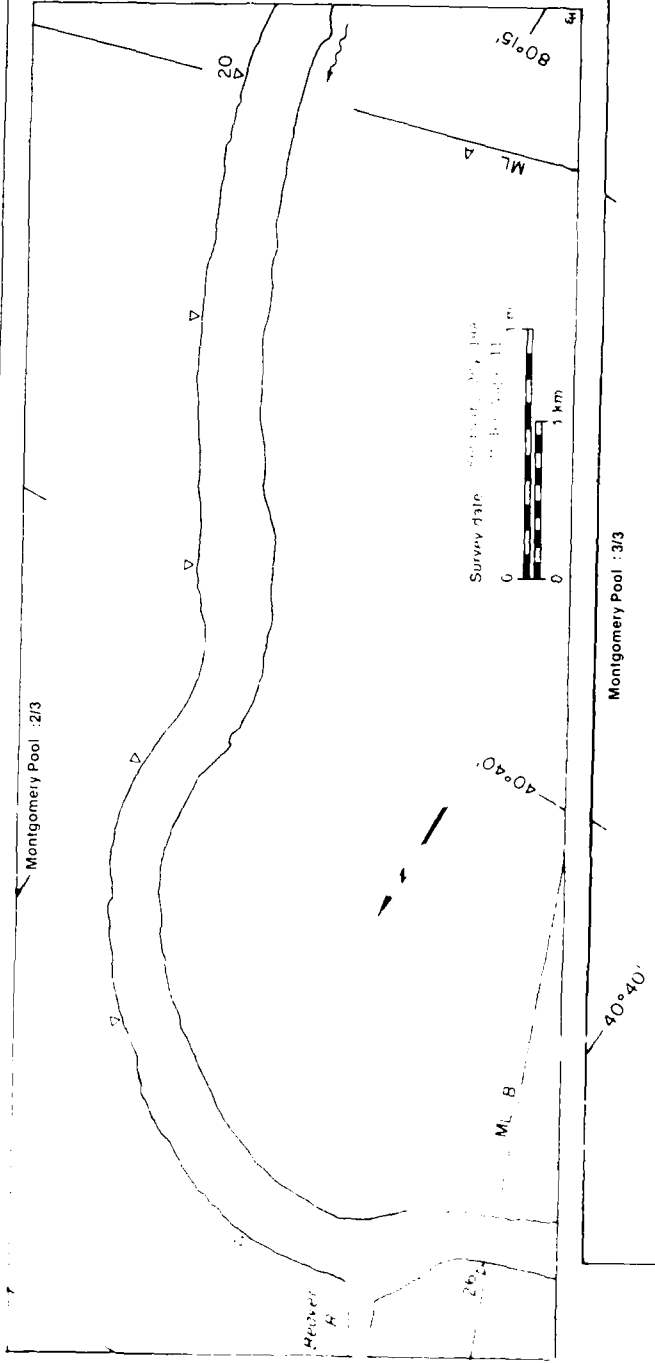
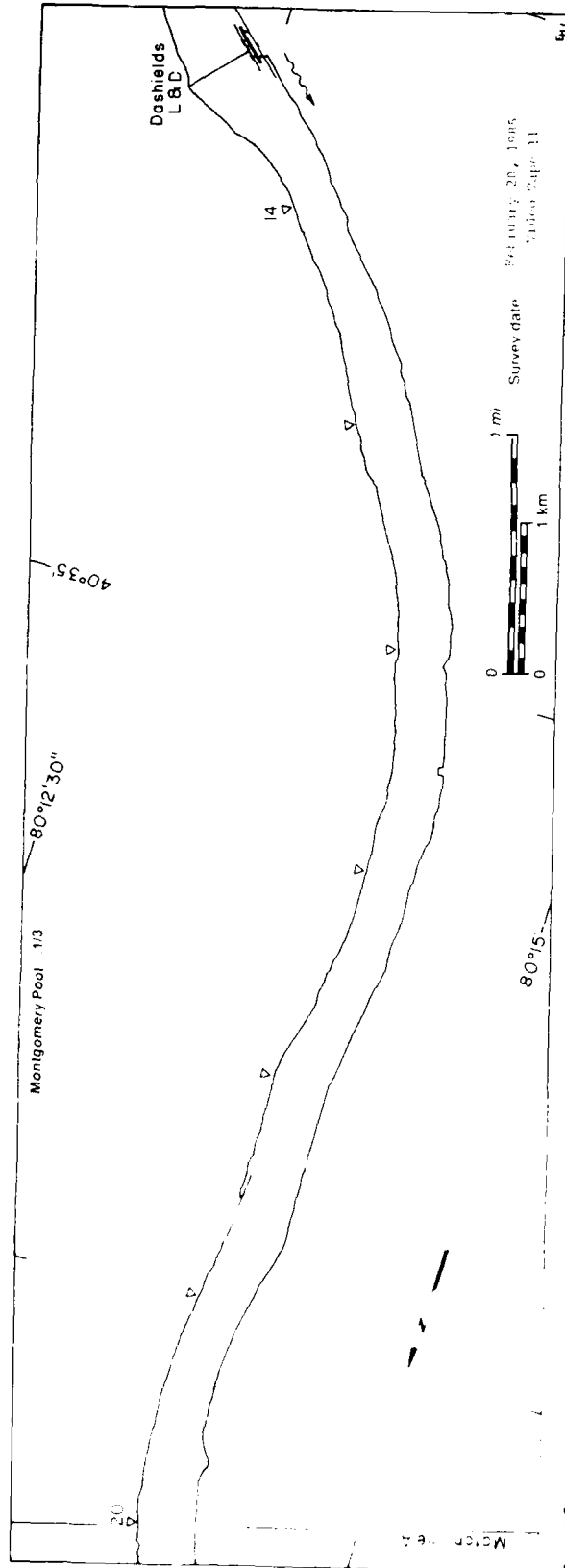
MAP UNITS

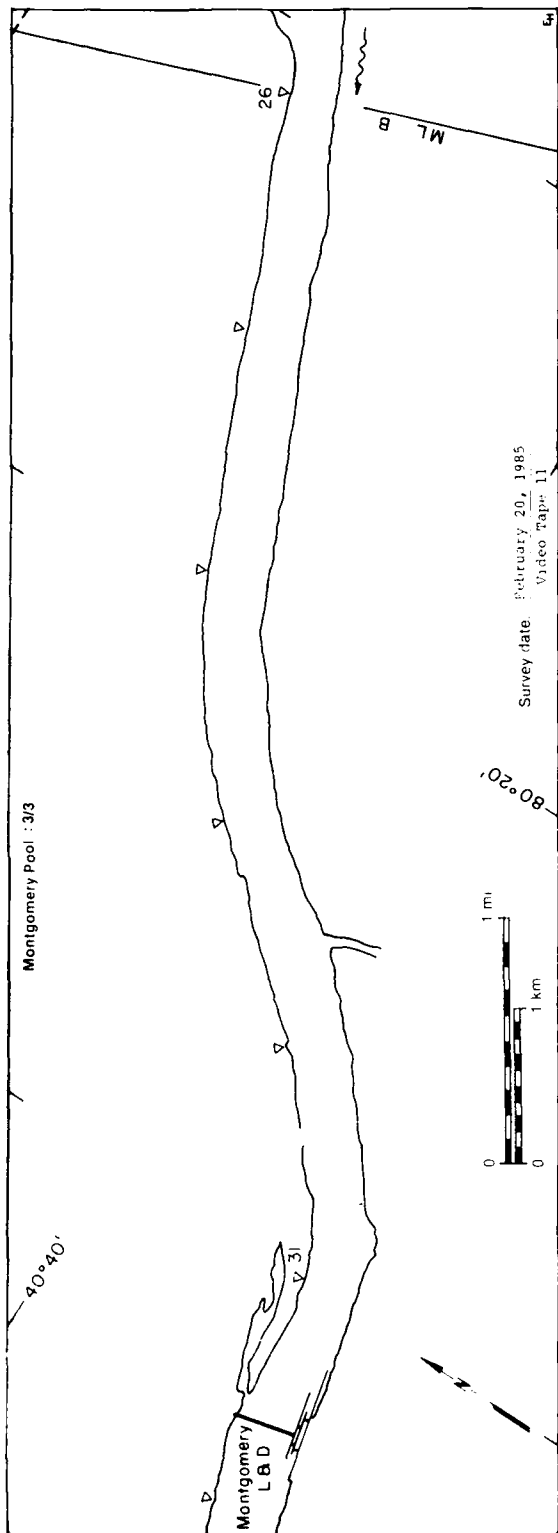


Area ($m^2 \times 10^6$)	Surface concentration (%)
4.16	NA
--	NA
--	--
--	NA
--	--
0.84	I
5.00	

Total Area ($m^2 \times 10^6$)

20 February 1985

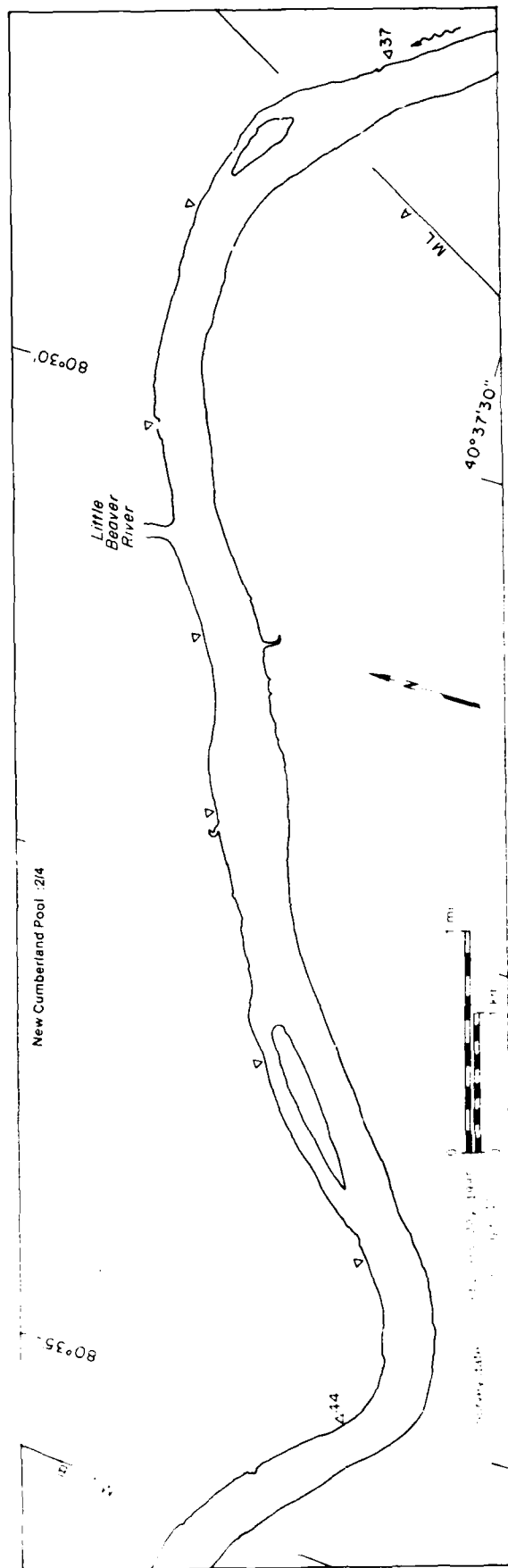
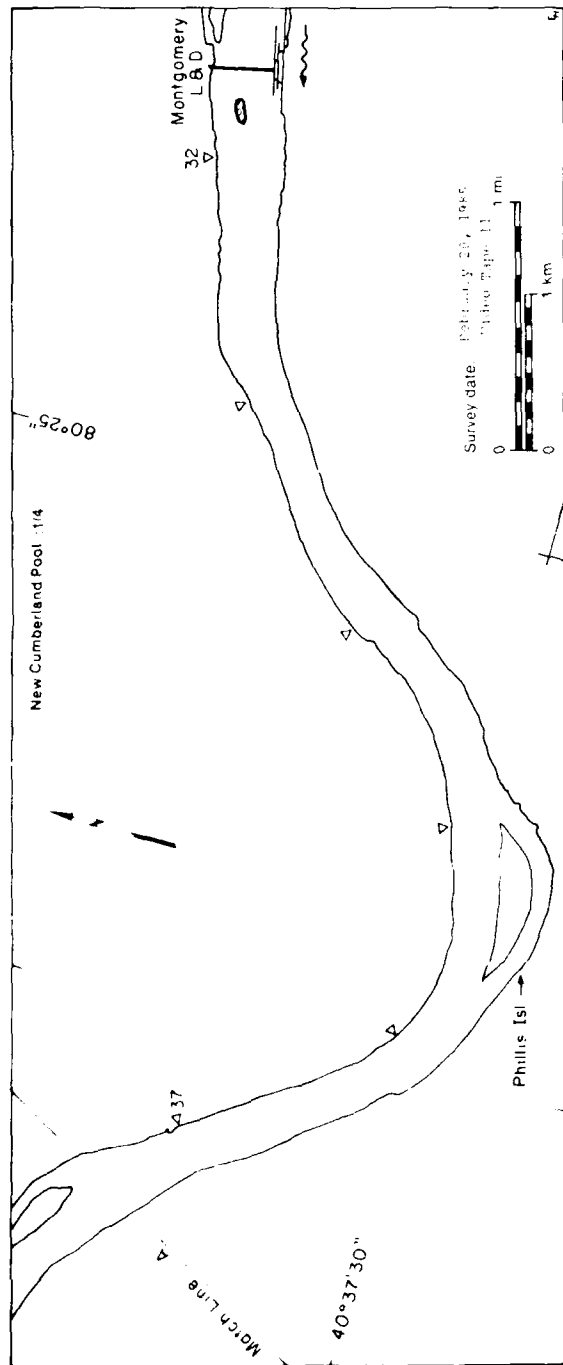




Survey date : February 20, 1985
Video Tape 11

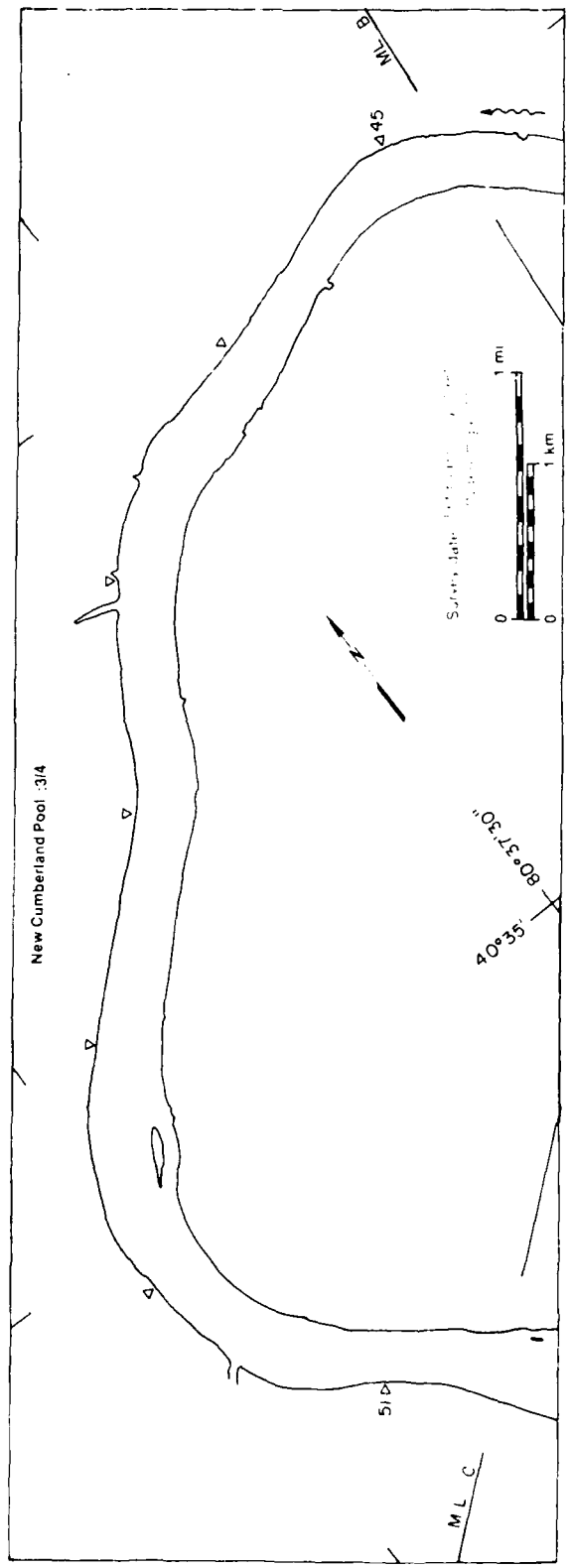
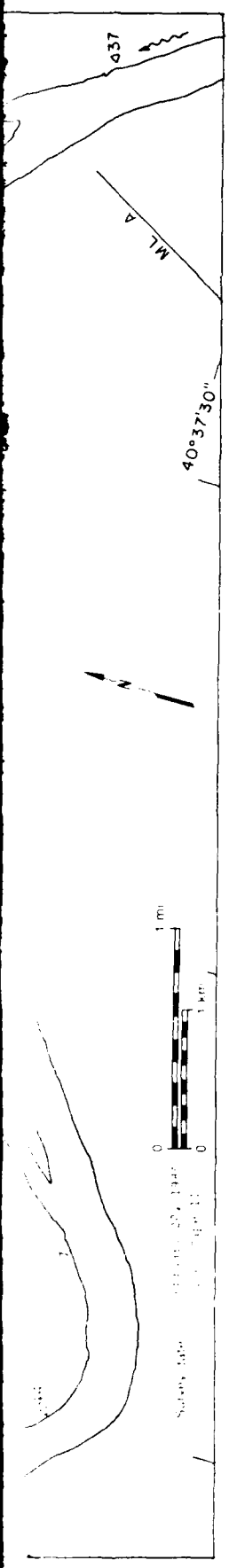
Montgomery Pool		Surface concentration	
MAP UNITS		($10^2 \times 10^6$)	(%)
Open water	NA	11.27	NA
Solid ice cover	NA	---	NA
Solid ice cover with open water areas	---	---	---
Fragmented ice cover	NA	---	NA
Fragmented ice cover with open water areas	---	---	---
Ice floes or frazil slush and pans	---	---	---
Total Area ($10^2 \times 10^6$)		11.27	

20 February 1985

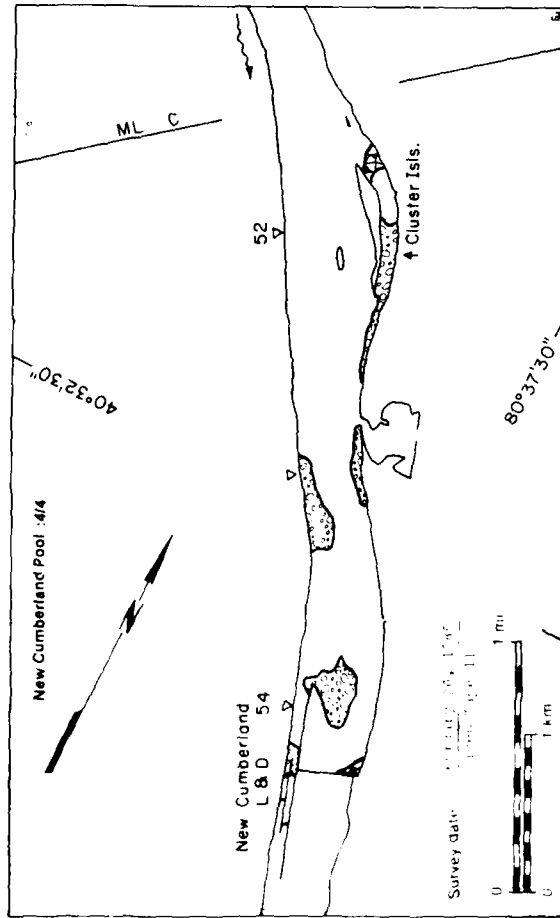


100

100

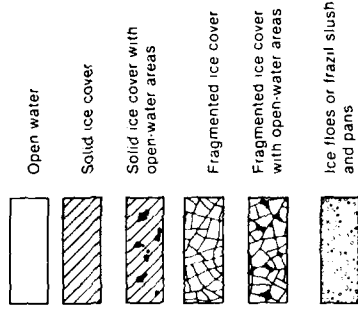


20 February 1985



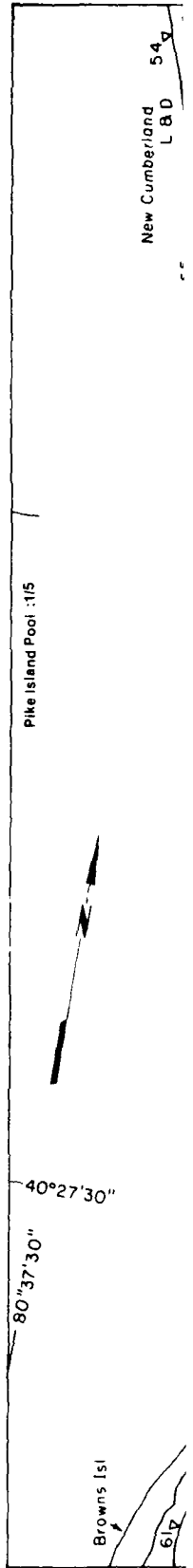
New Cumberland Pool

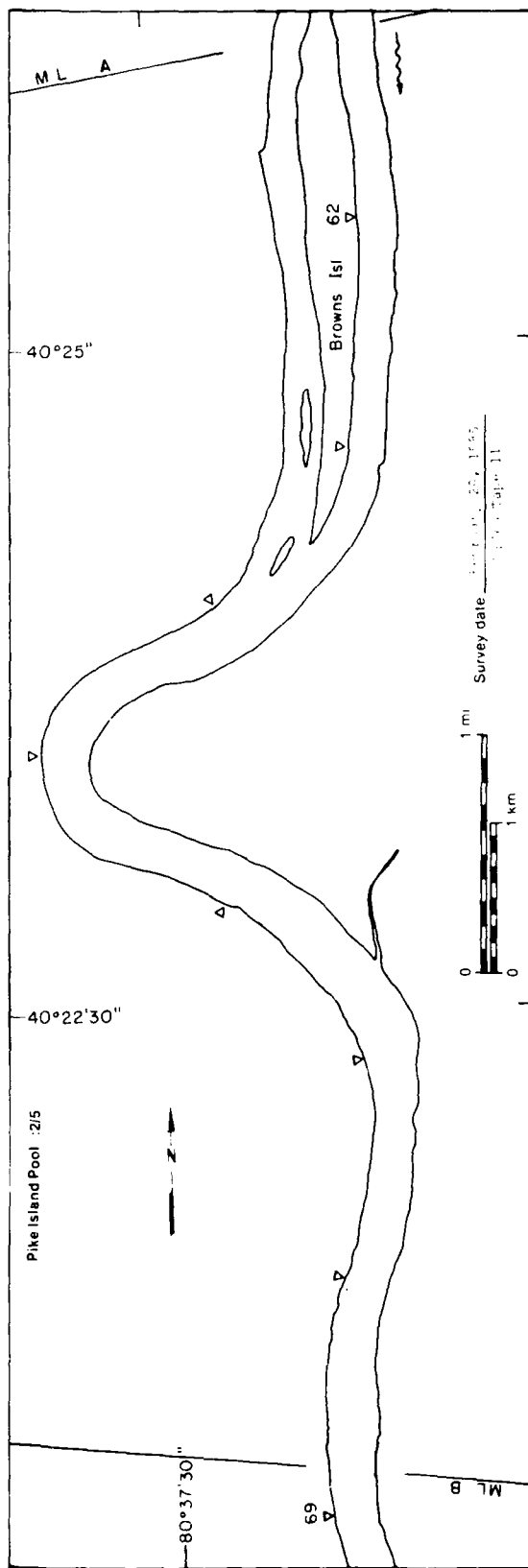
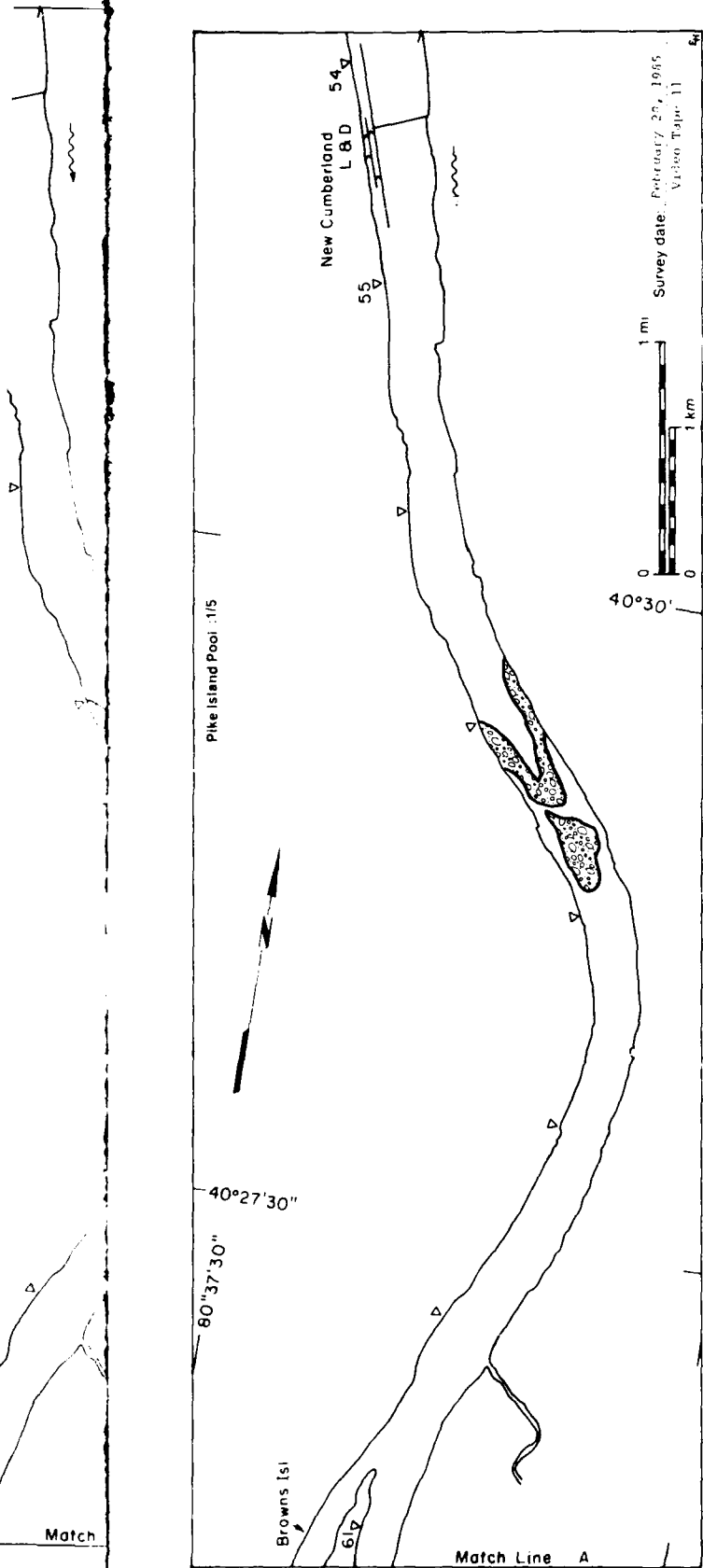
MAP UNITS



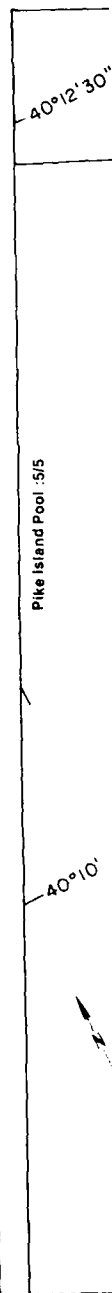
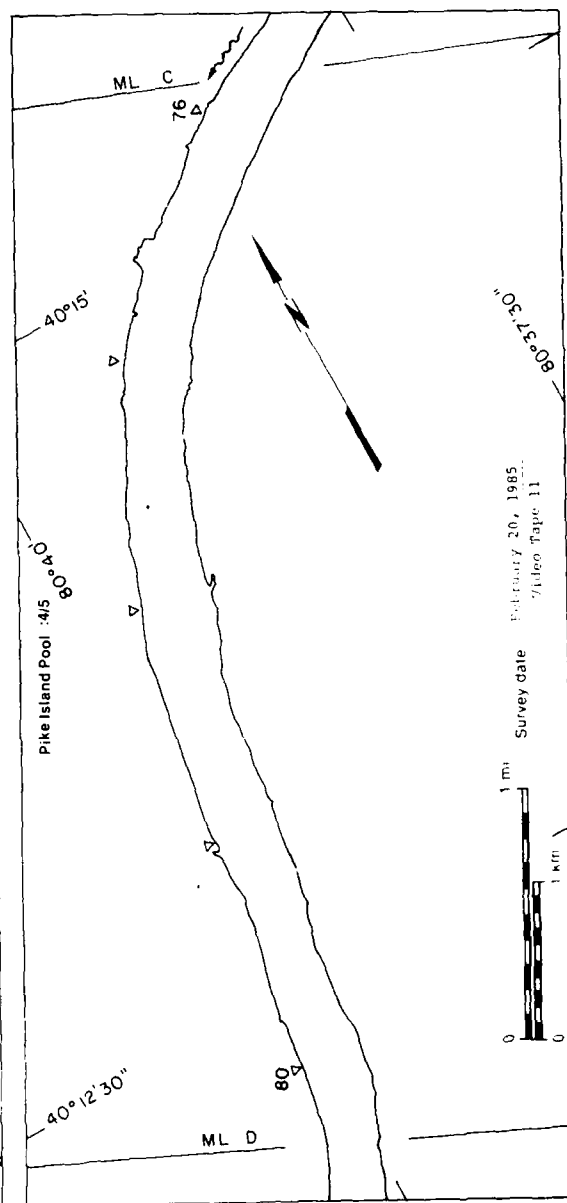
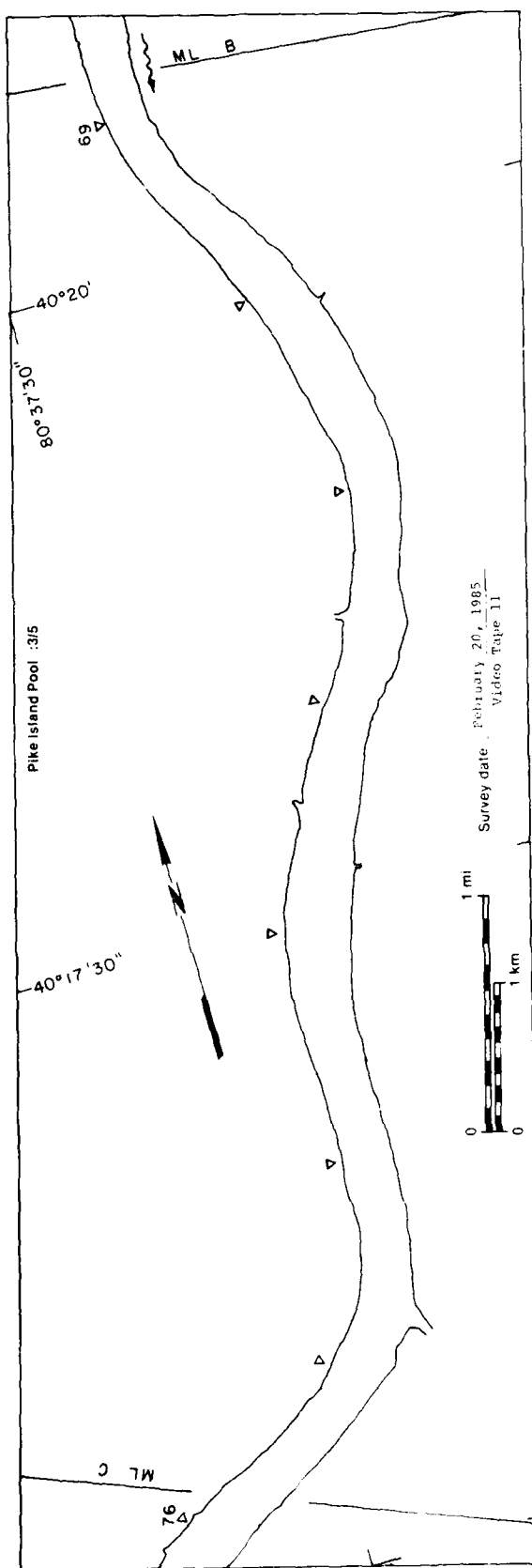
Area (m ² x 10 ⁶)	Surface concentration (%)
14.52	NA
—	NA
—	—
—	NA
0.03	90
0.32	2
14.97	

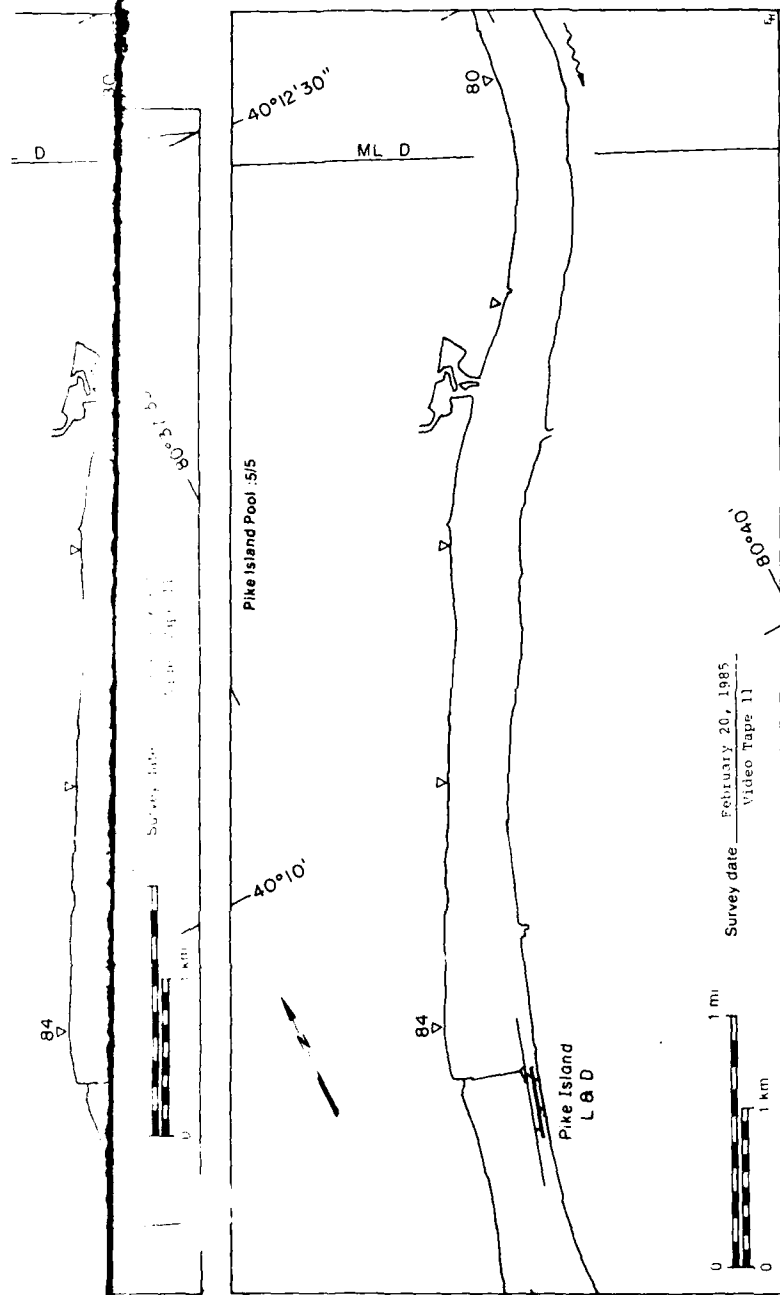
Total Area (m² x 10⁶)





20 February 1985

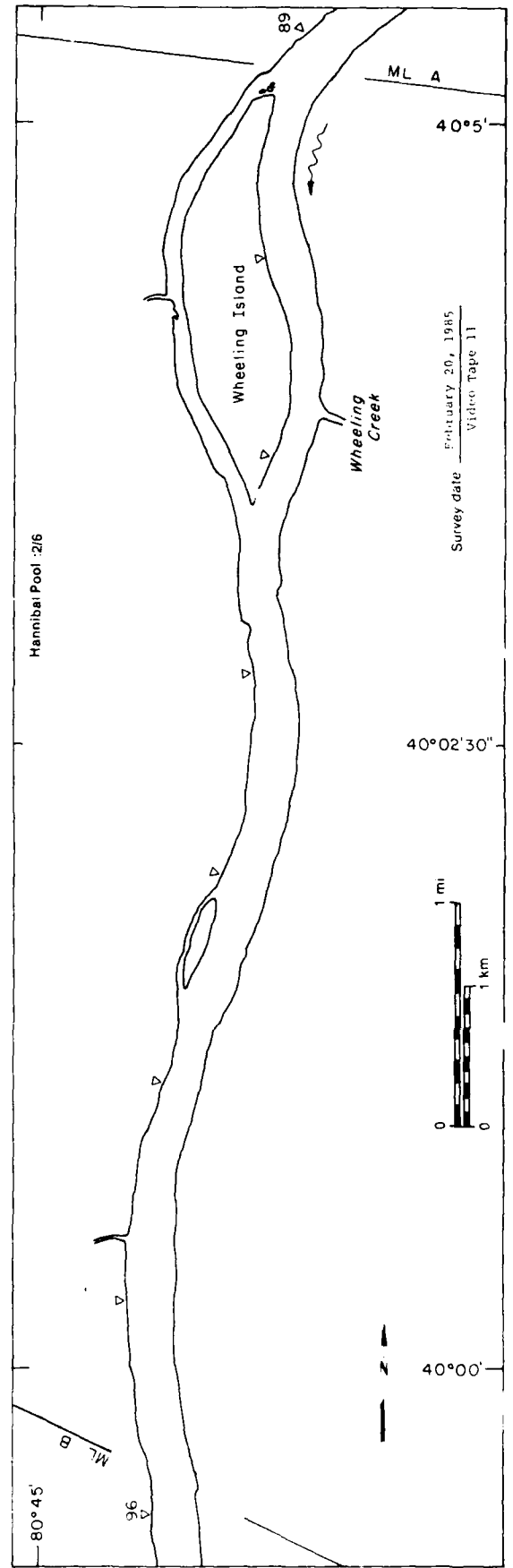
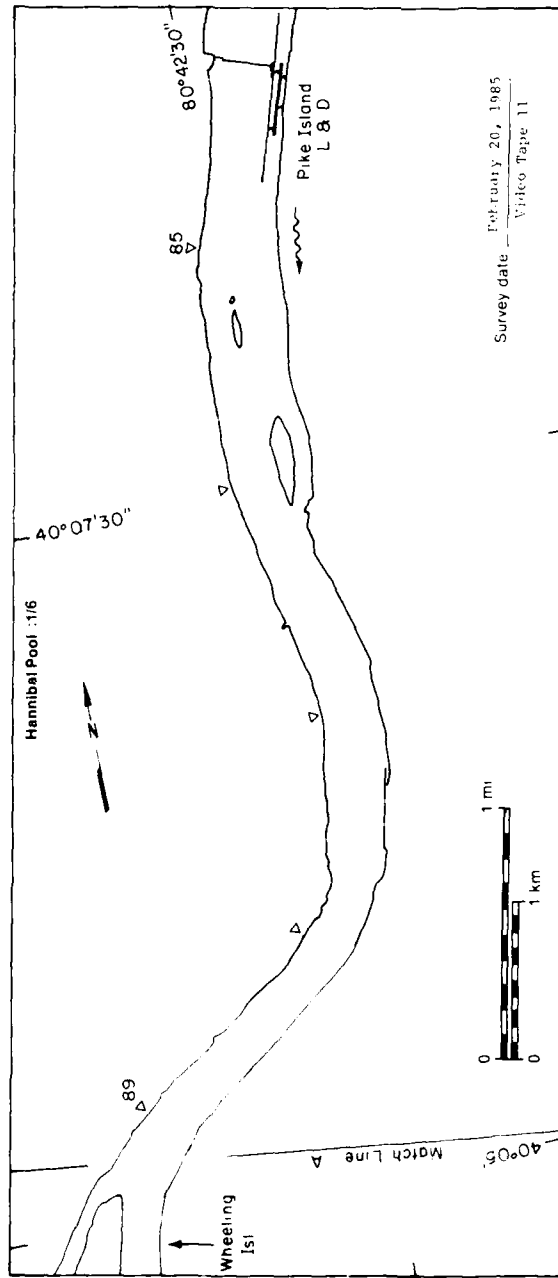


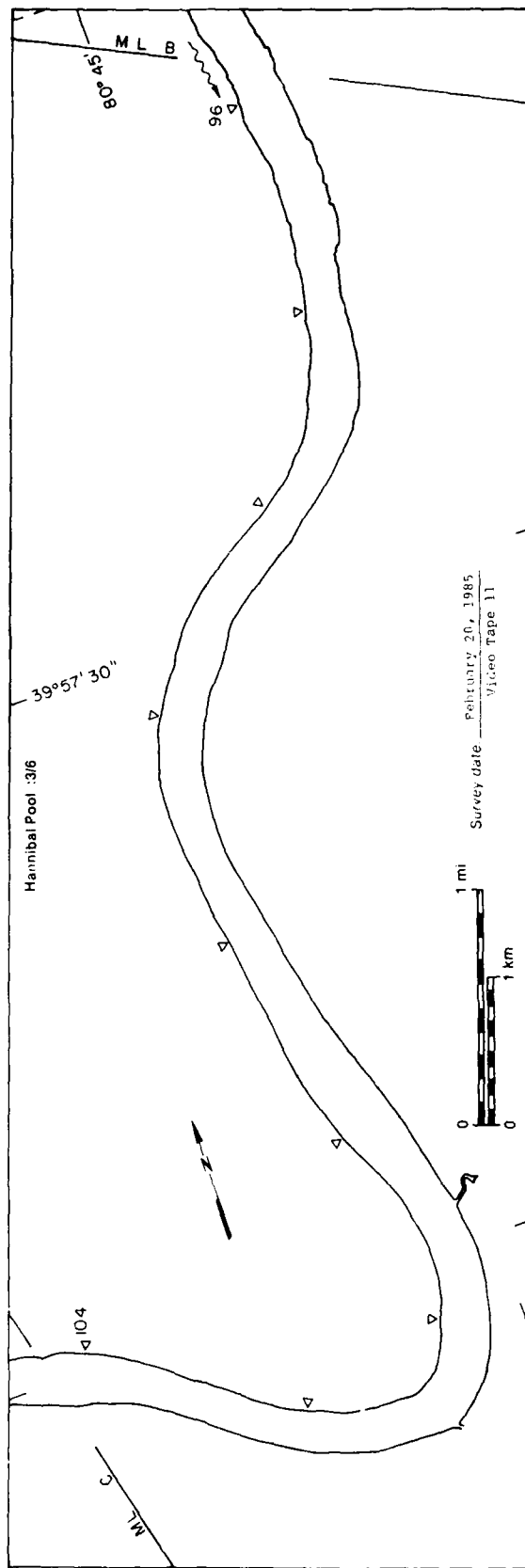
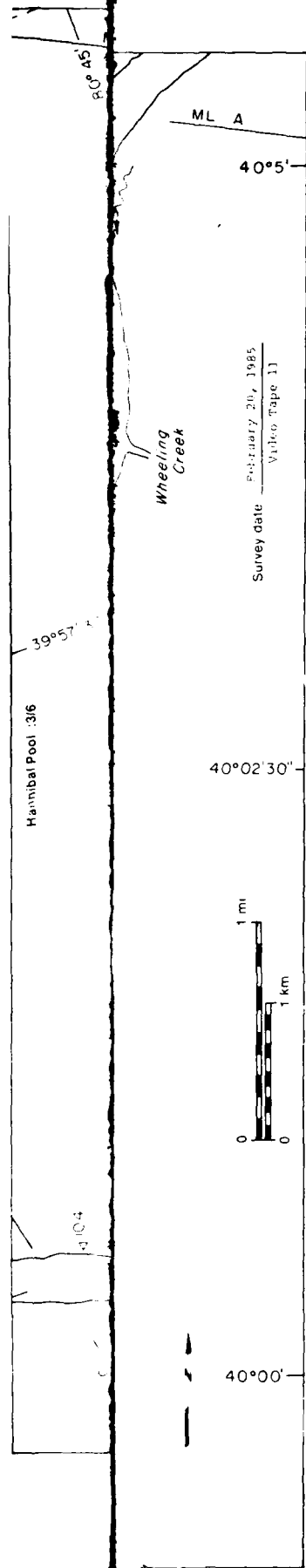


Pike Island Pool

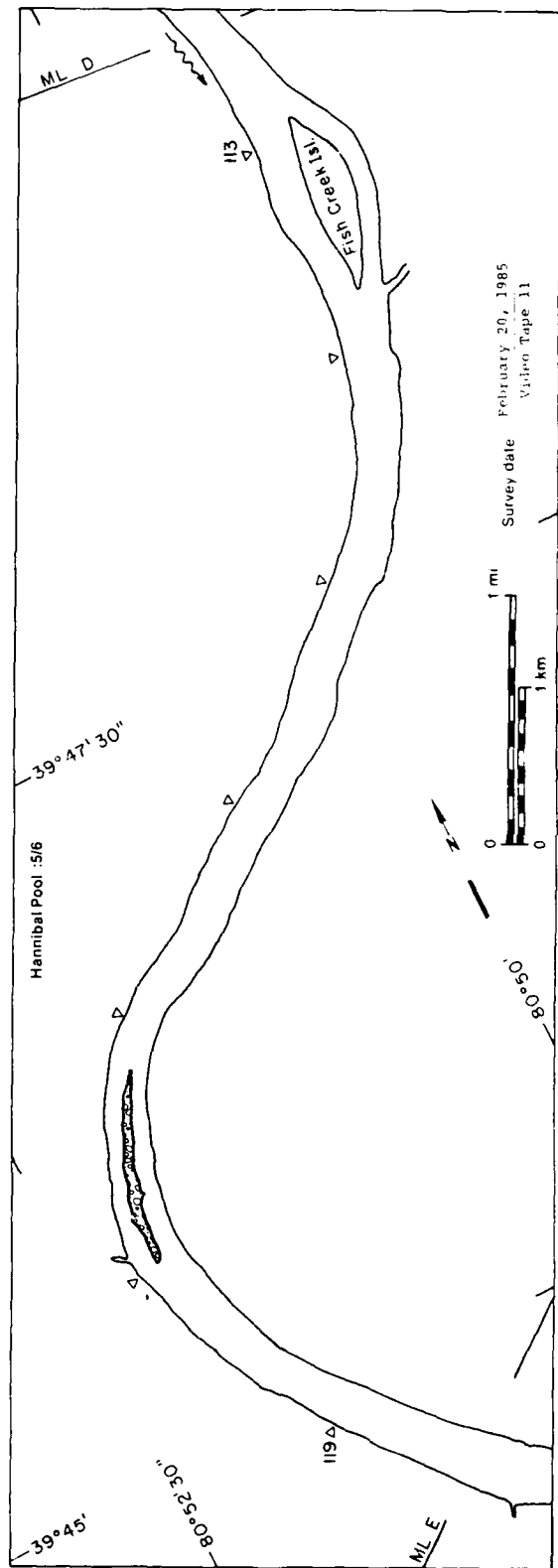
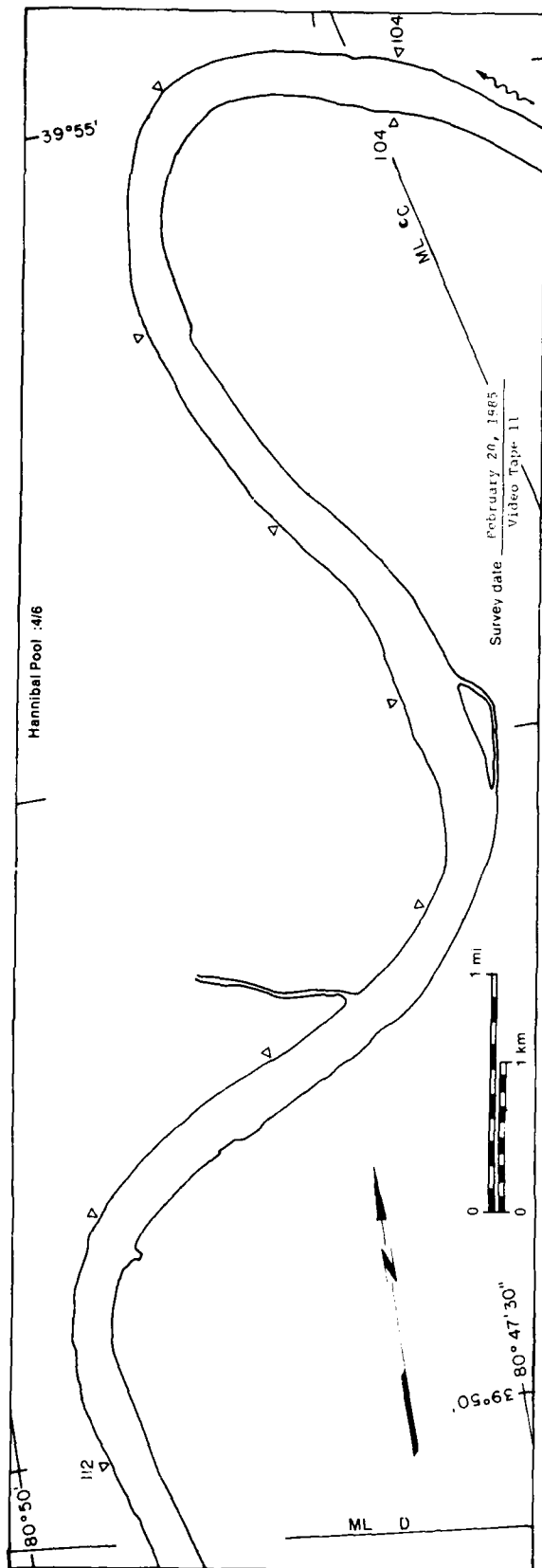
MAP UNITS	Area, $m^2 \times 10^5$	Surface concentration (%)
Open water	18.64	NA
Solid ice cover	--	NA
Solid ice cover with open water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open water areas	--	--
Ice floes or frazil slush and pans	0.28	1
Total Area ($m^2 \times 10^5$)	18.92	

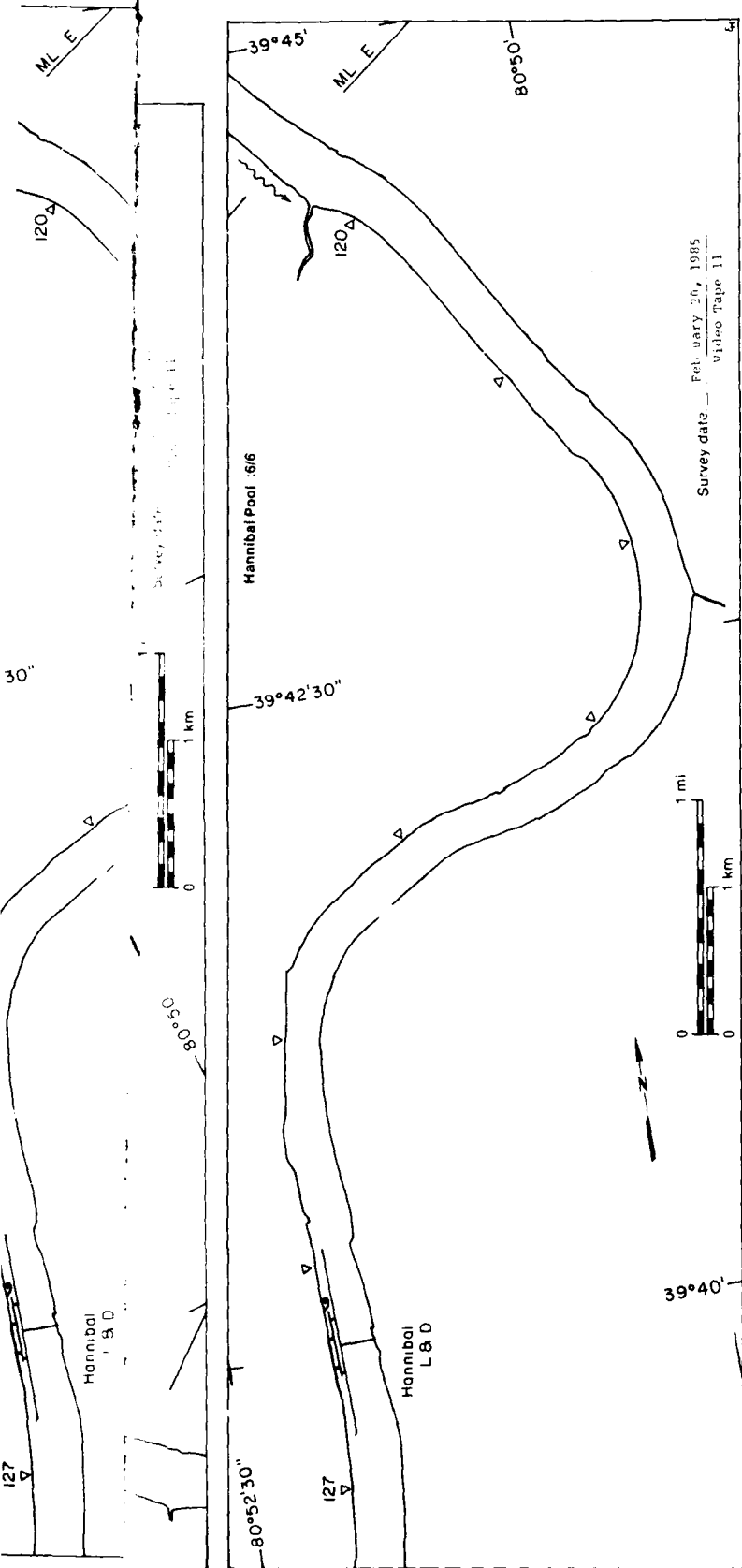
20 February 1985





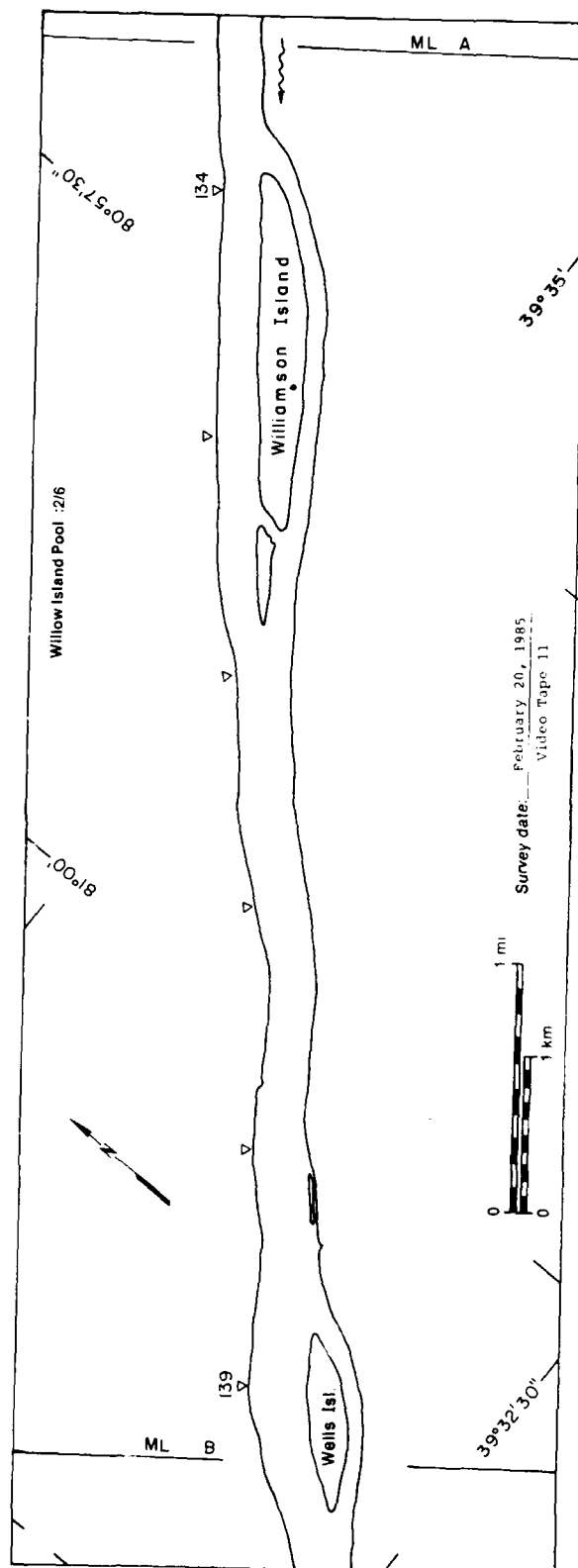
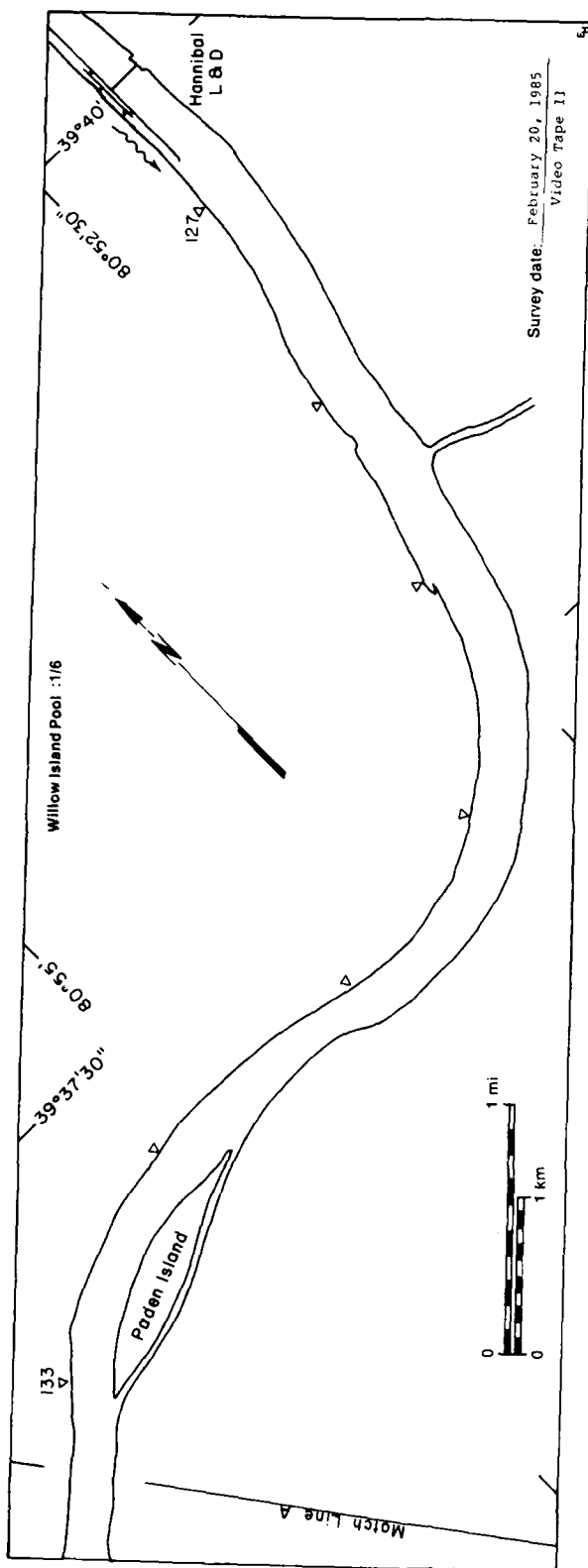
20 February 1985

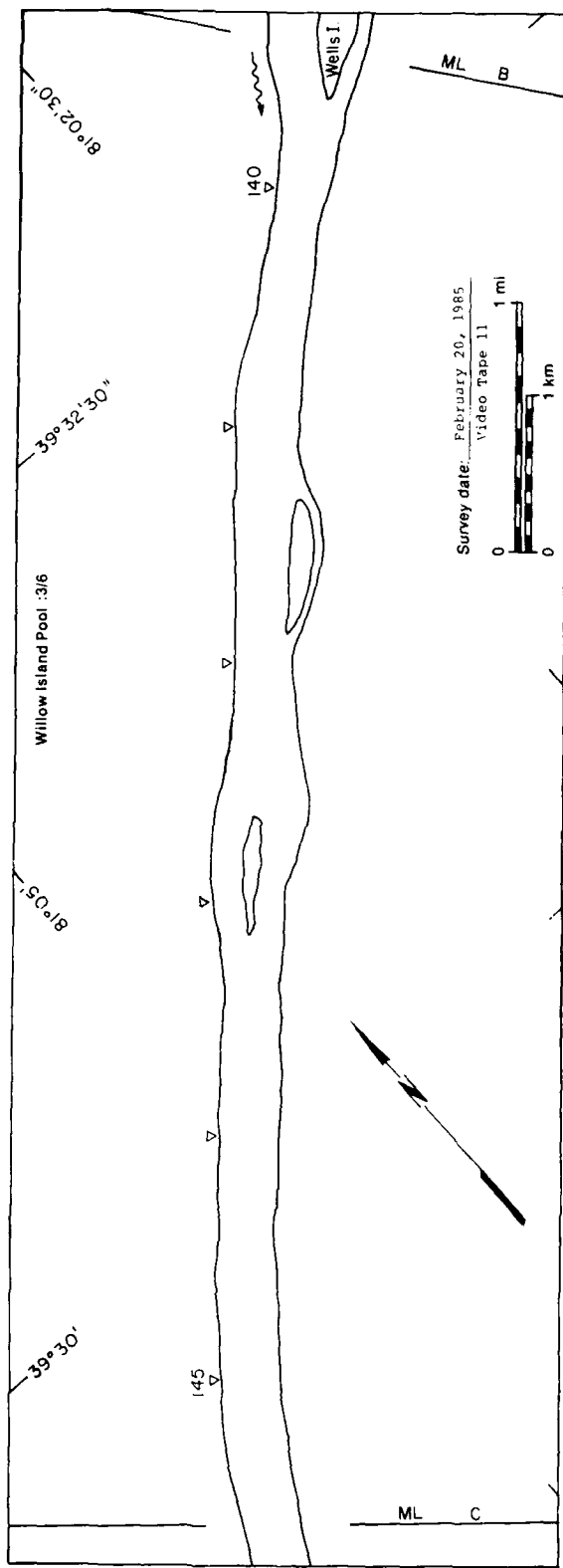
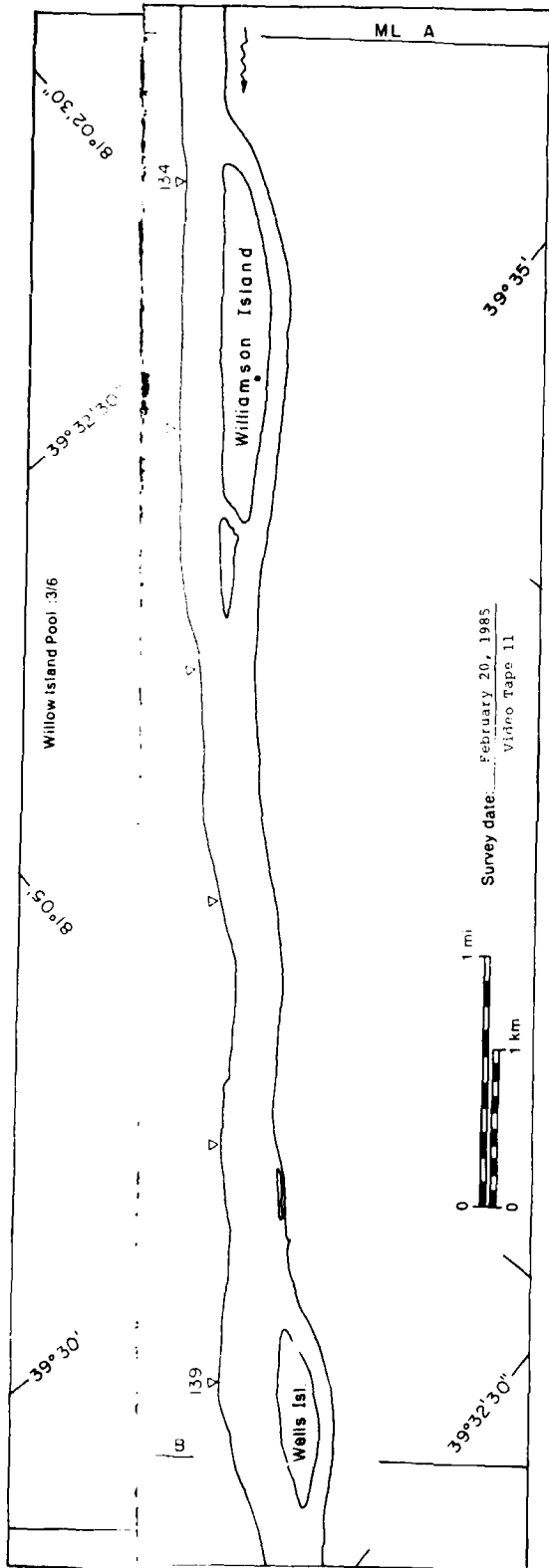




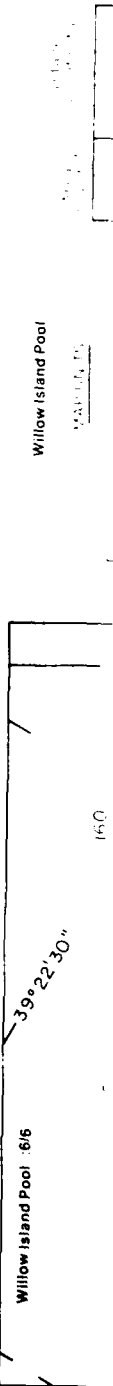
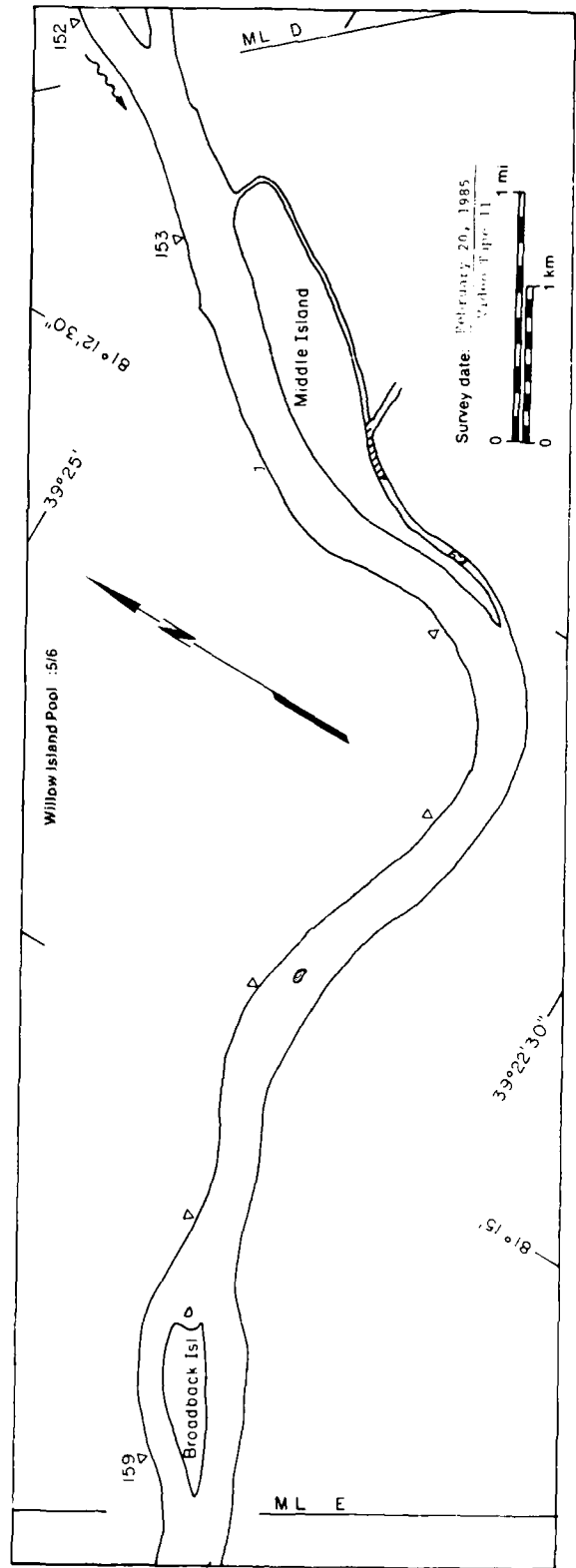
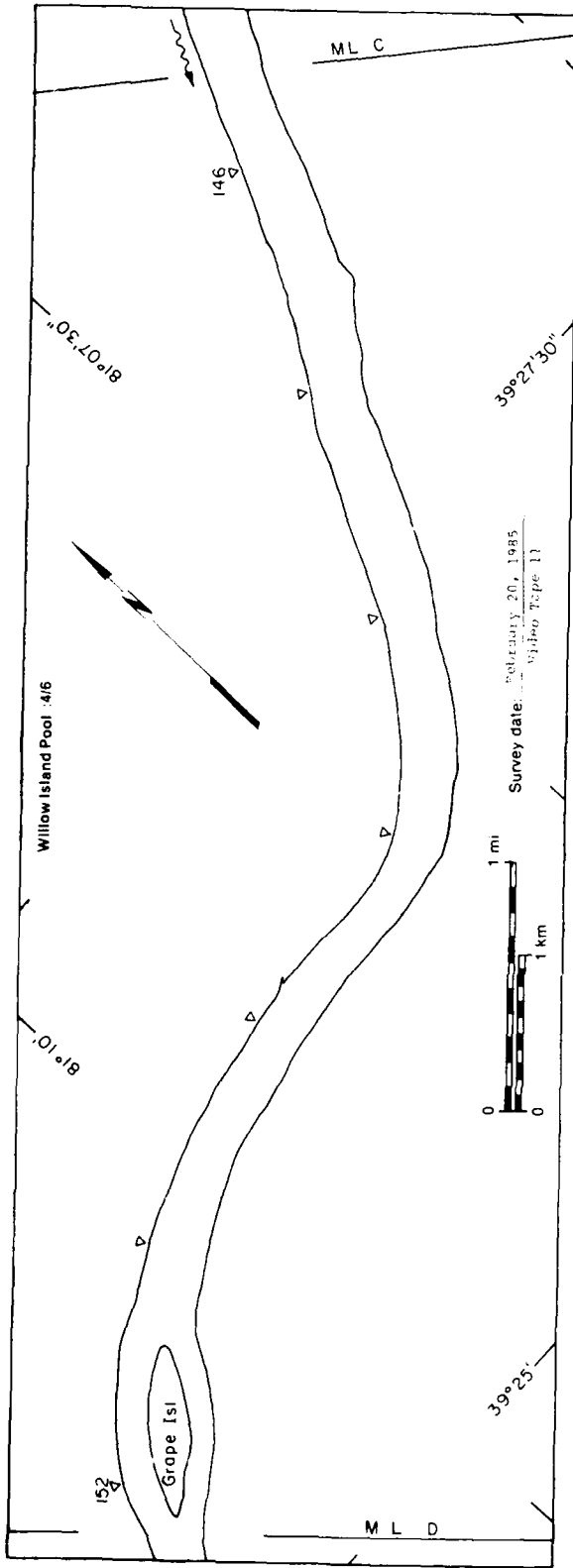
Hannibal Pool		Surface concentration	
MAP UNITS	(m ² Area x 10 ⁶)	(%)	
Open water	22.35	NA	
Solid ice cover	--	NA	
Solid ice cover with open water areas	--	--	
Fragmented ice cover	--	NA	
Fragmented ice cover with open water areas	--	--	
Ice floes or frazil slush and pans	0.11	1	
Total Area (m ² x 10 ⁶)		22.46	

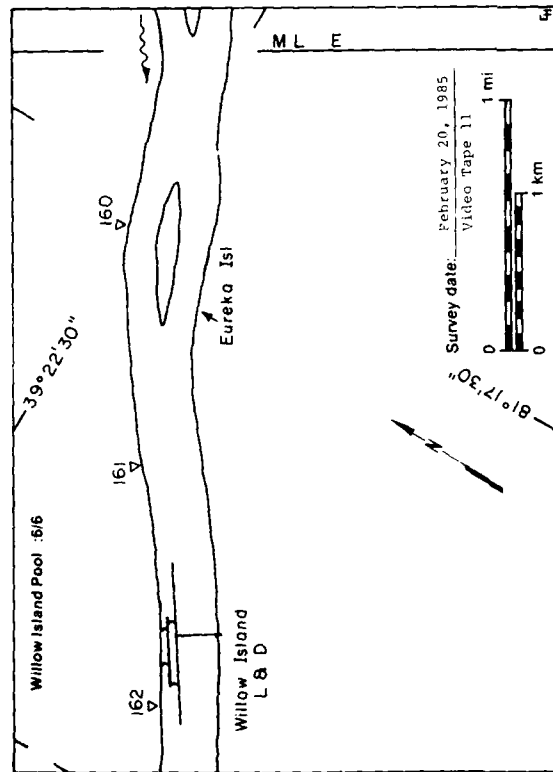
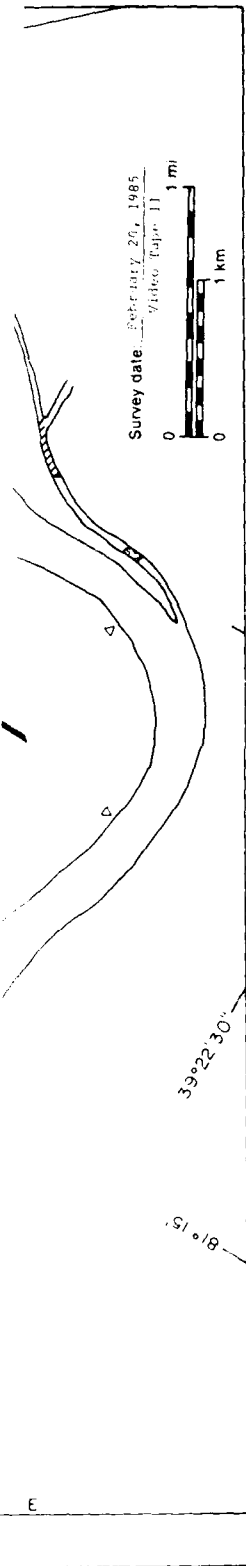
20 February 1985





20 February 1985





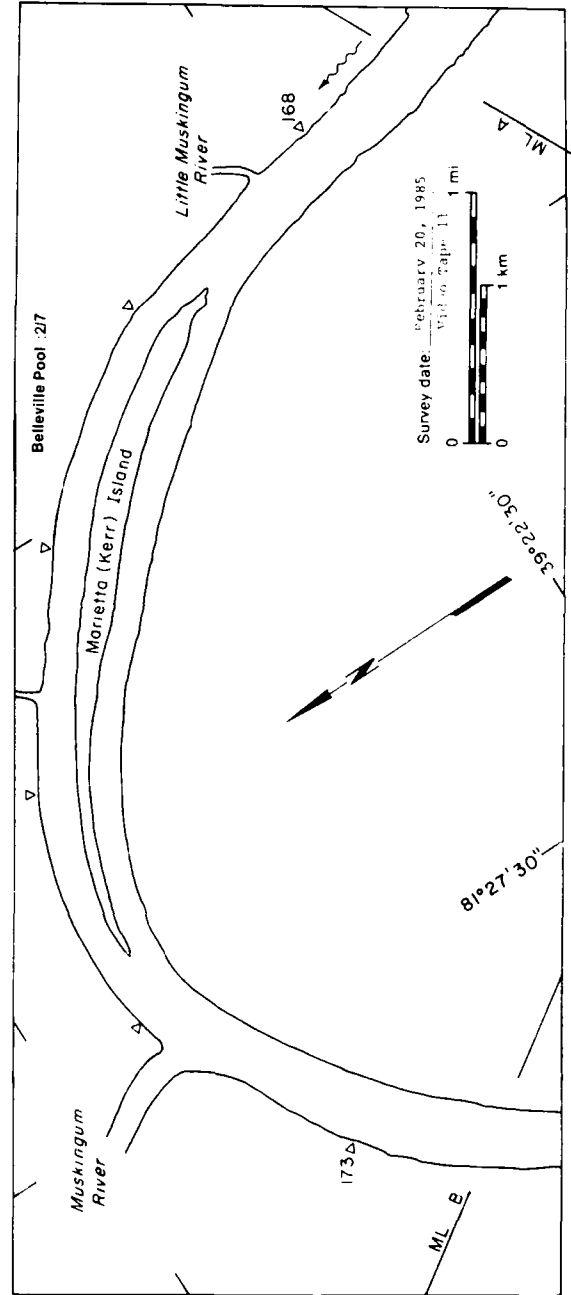
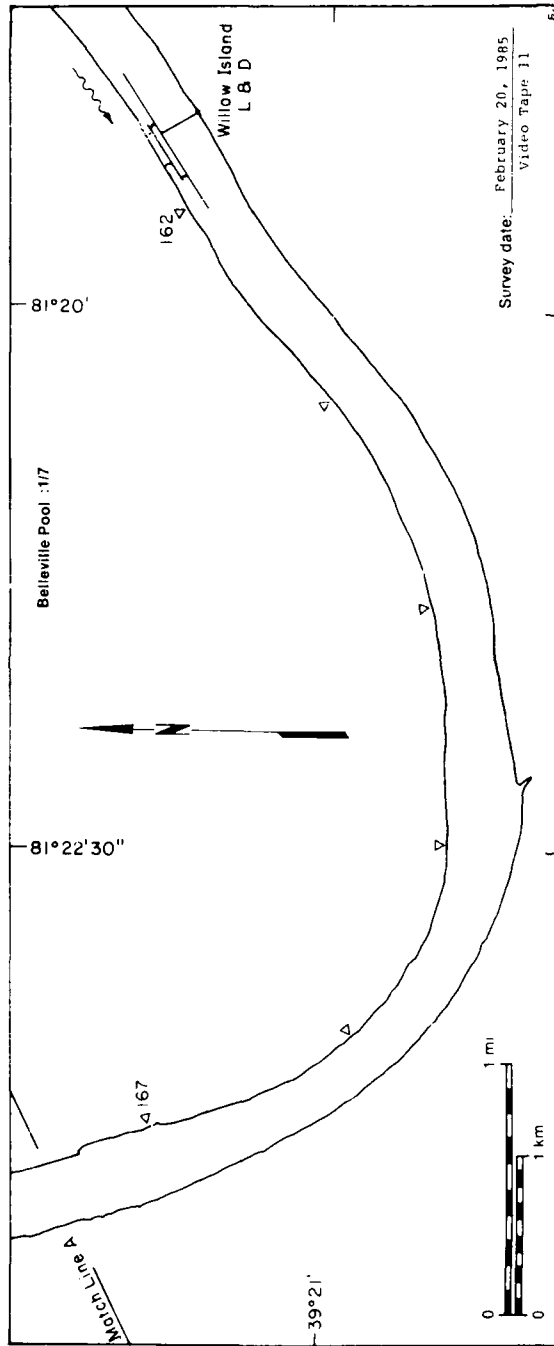
Willow Island Pool

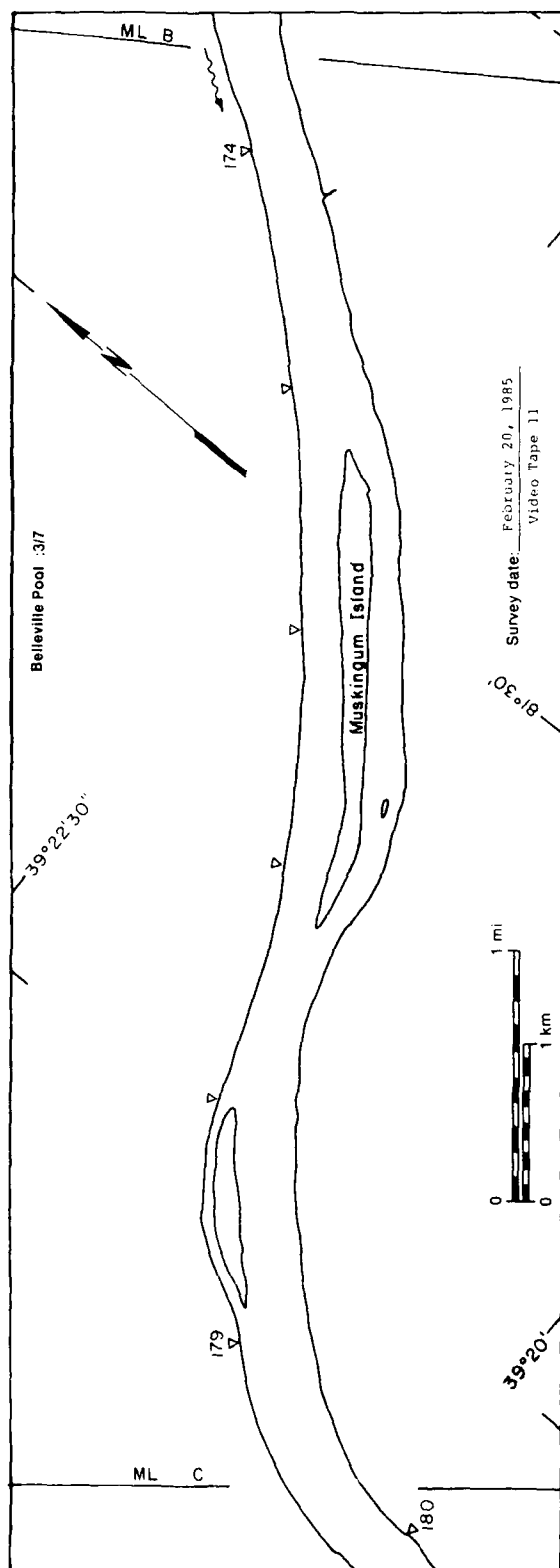
MAP UNITS

Open water	21.21	NA
Solid ice cover	0.03	NA
Solid ice cover with open water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open-water areas	--	--
Ice floes or frazil slush and pans	Trace	?
Total Area ($m^2 \times 10^6$)	21.24	

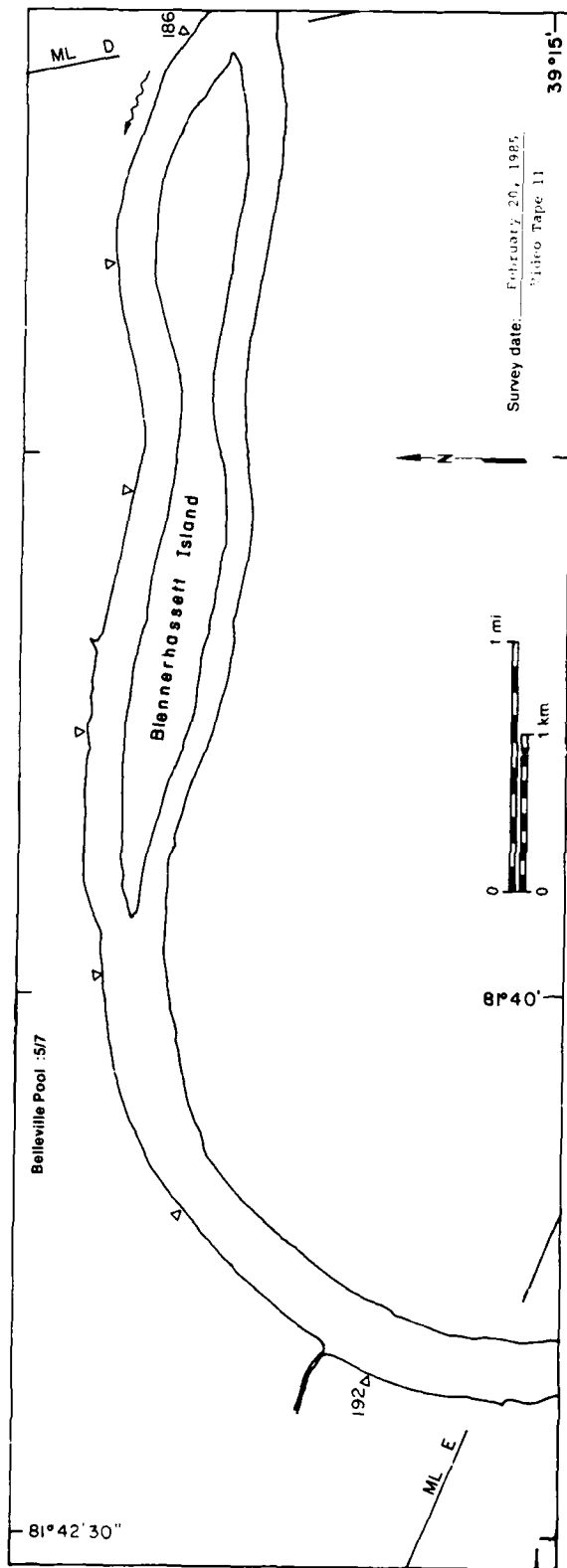
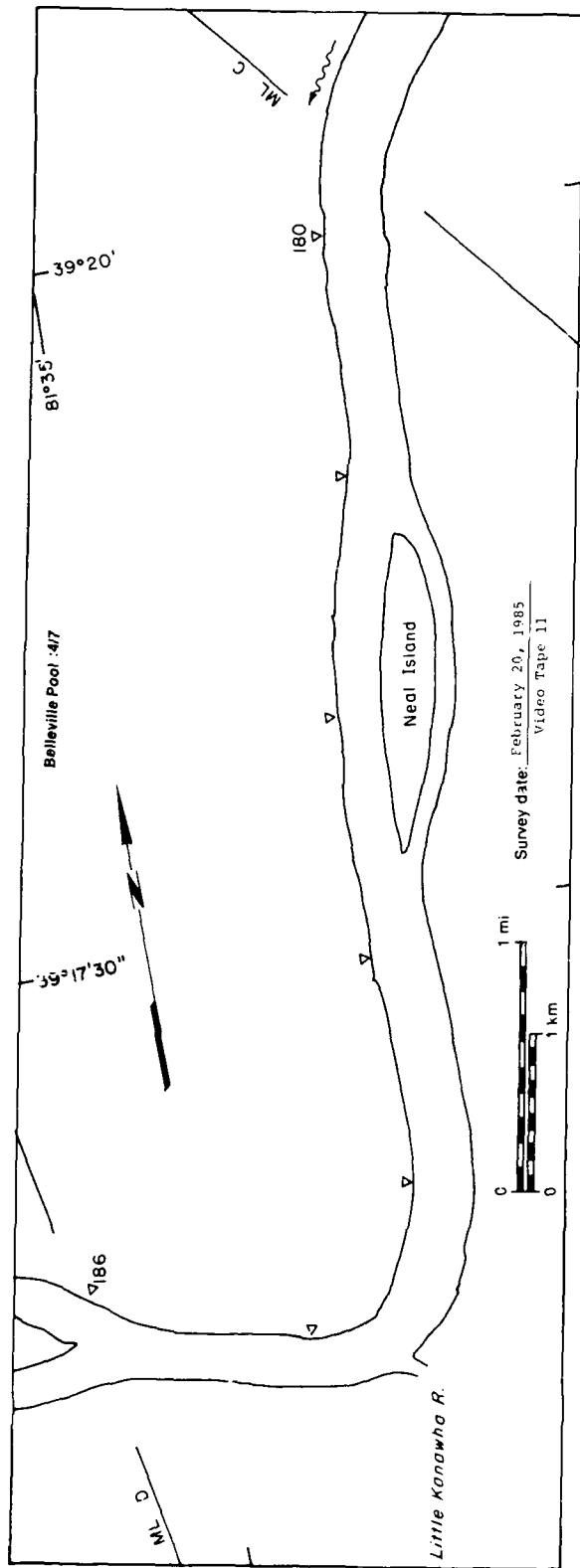
Surface concentration (%)

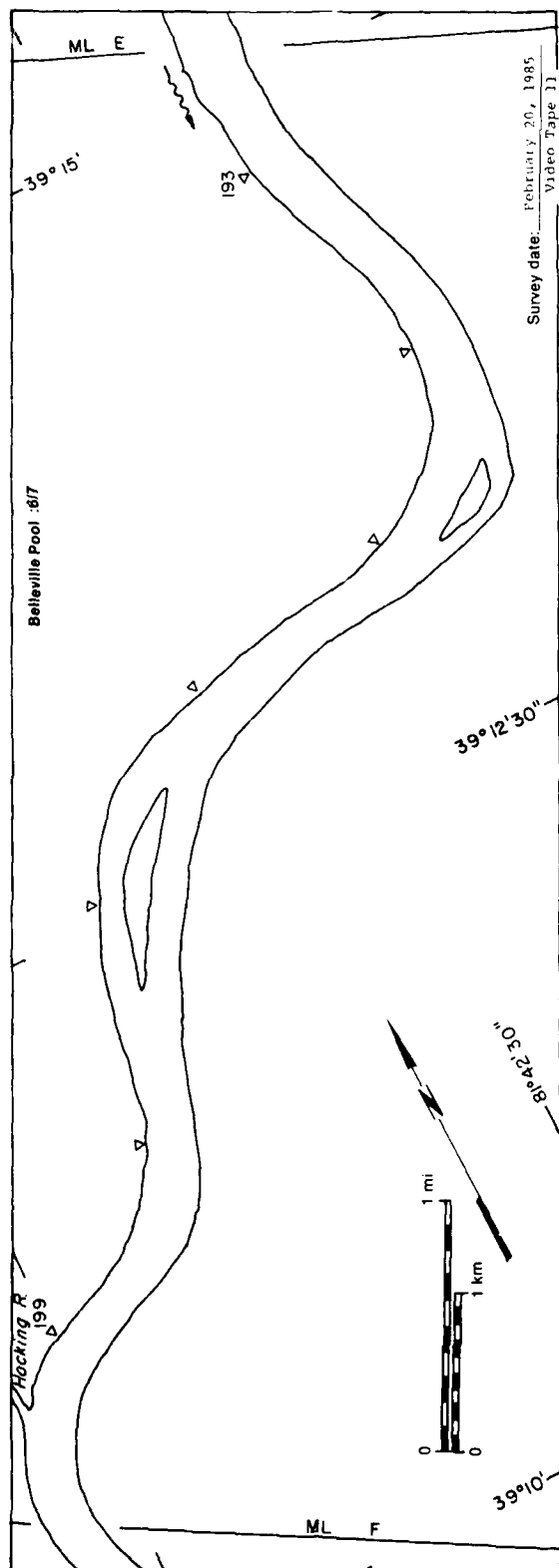
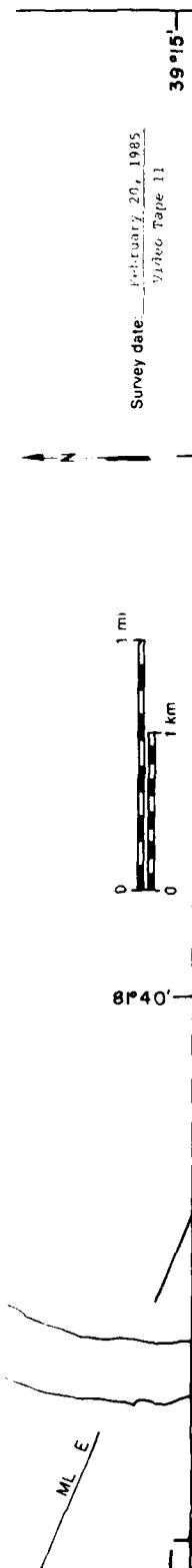
20 February 1985



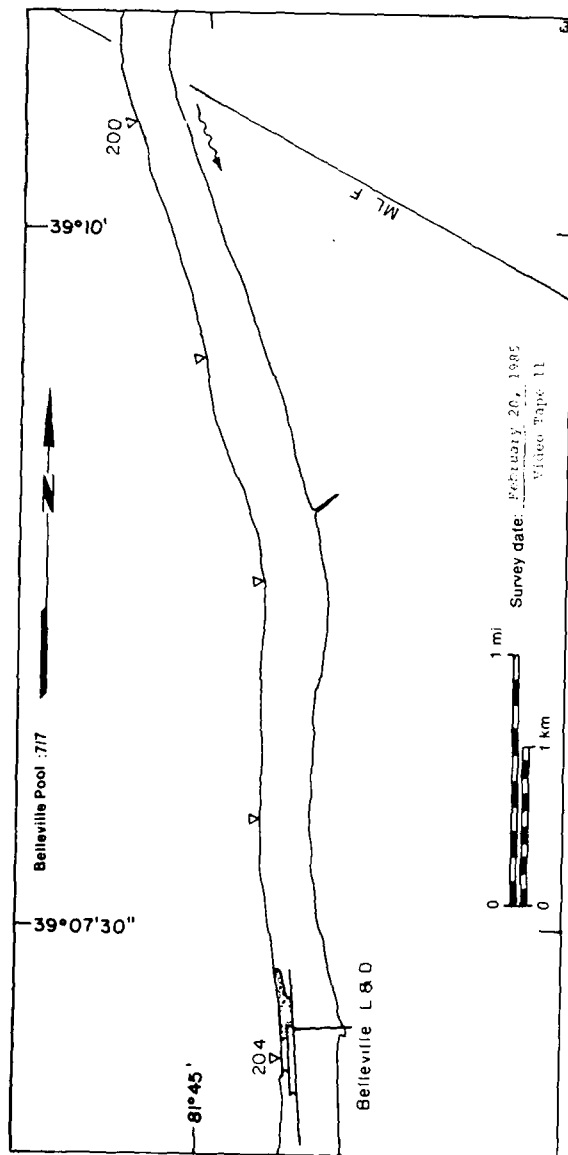


20 February 1985





20 February 1985

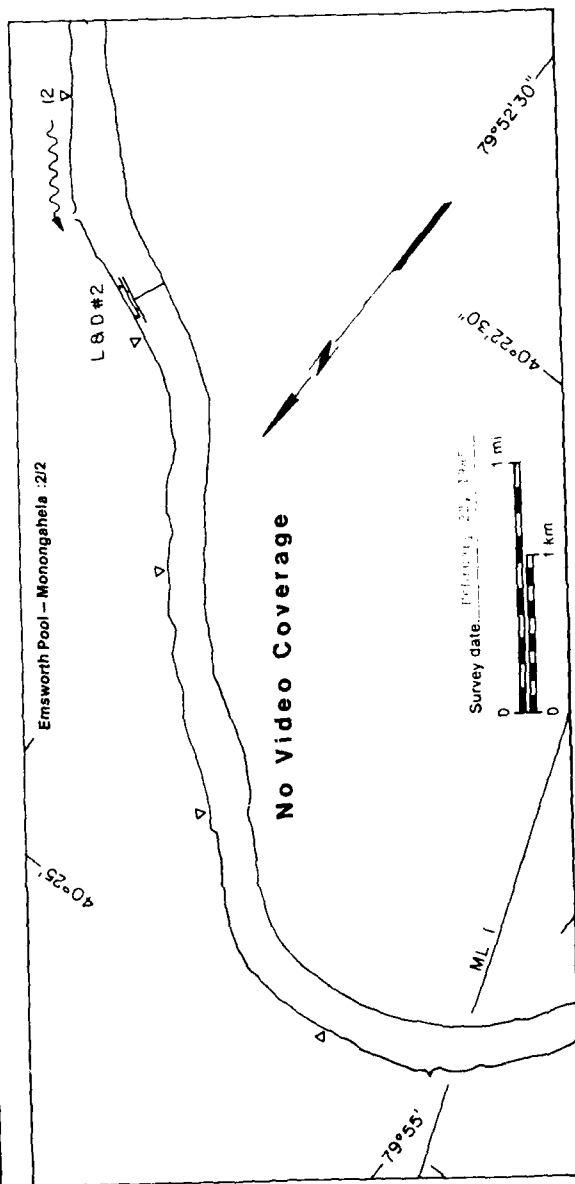
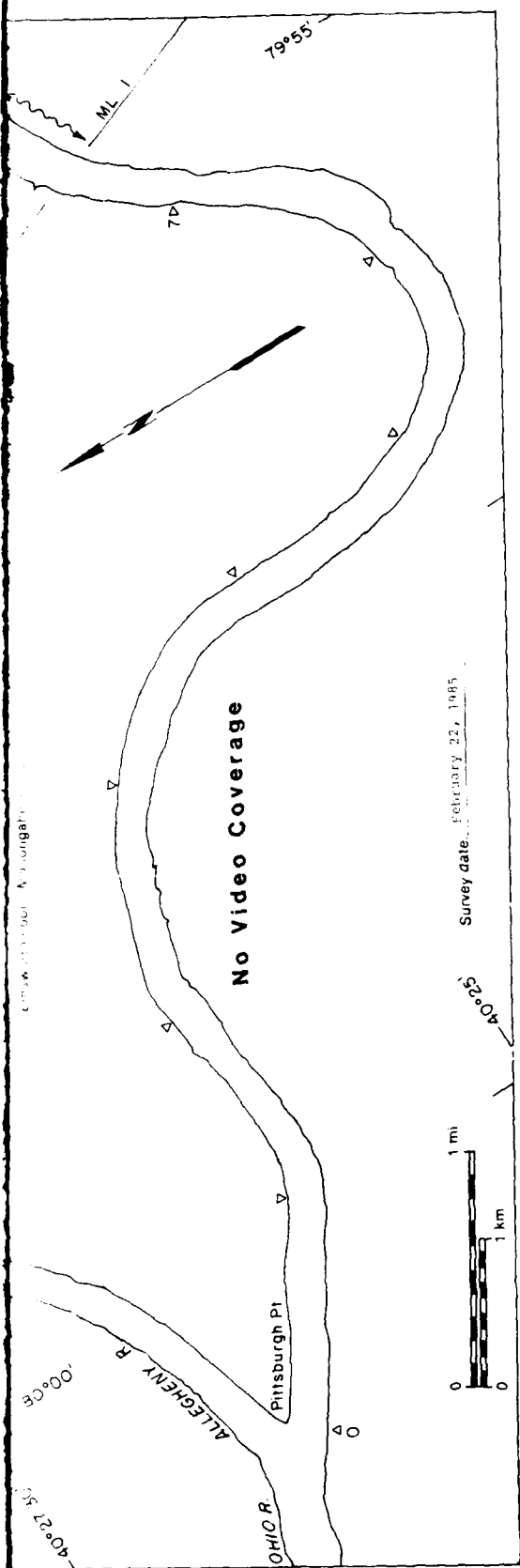


Survey date: February 20, 1985
Video Tape 11

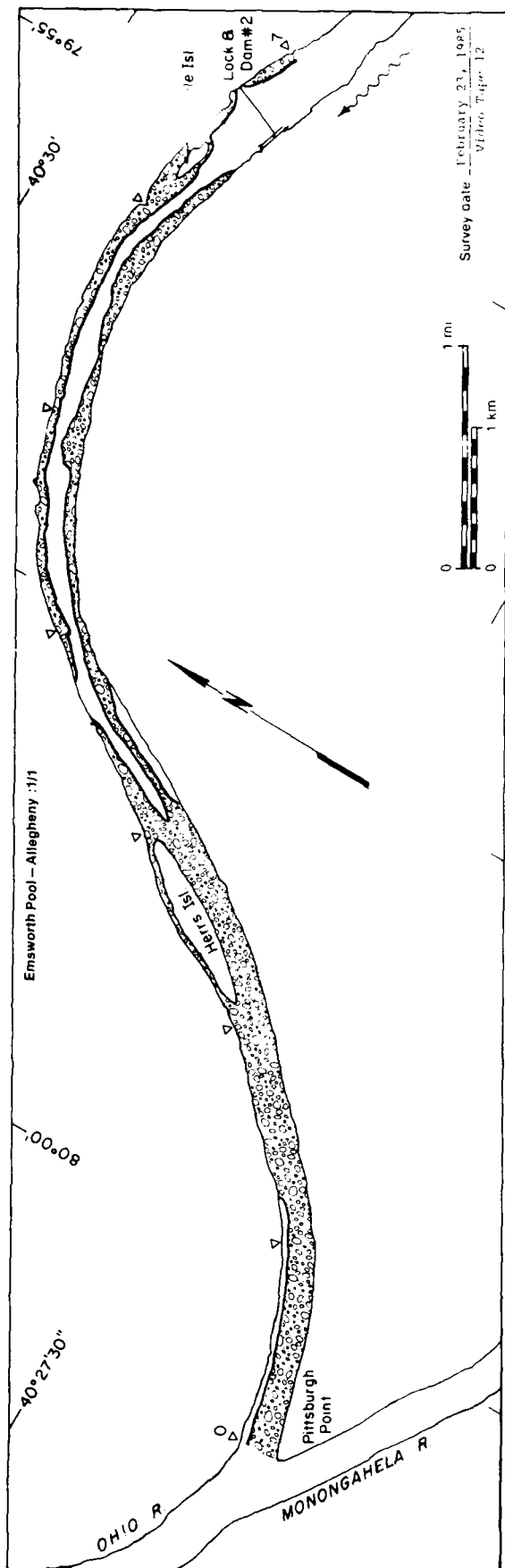
Belleville Pool

MAP UNITS

	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	27.24	NA
Solid ice cover	--	NA
Solid ice cover with open water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open water areas	--	--
Ice floes or frazil slush and pans	7.24	1
Total Area (m ² x 10 ⁶)	27.28	



23 February 1985

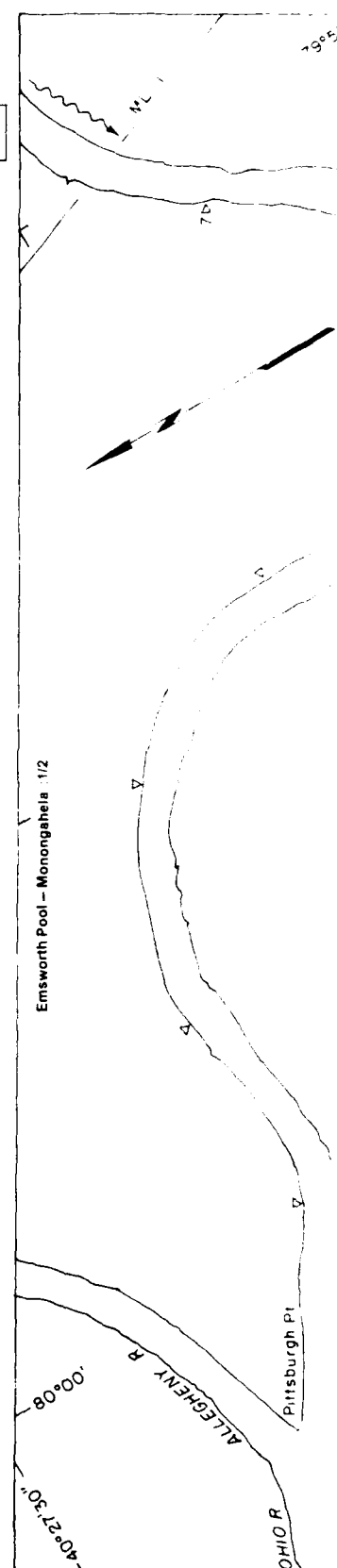


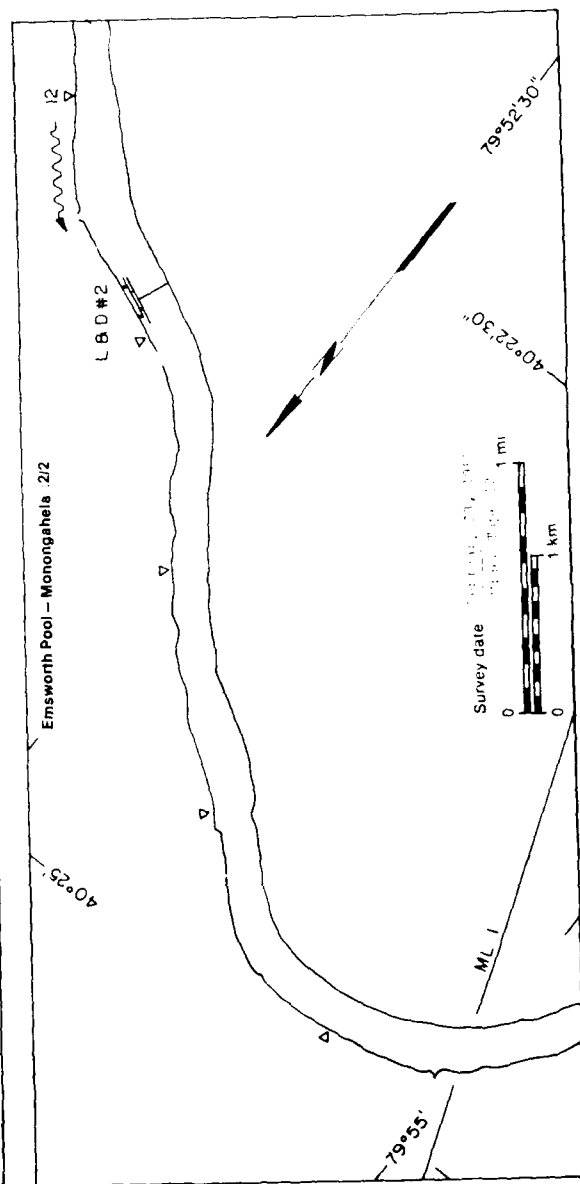
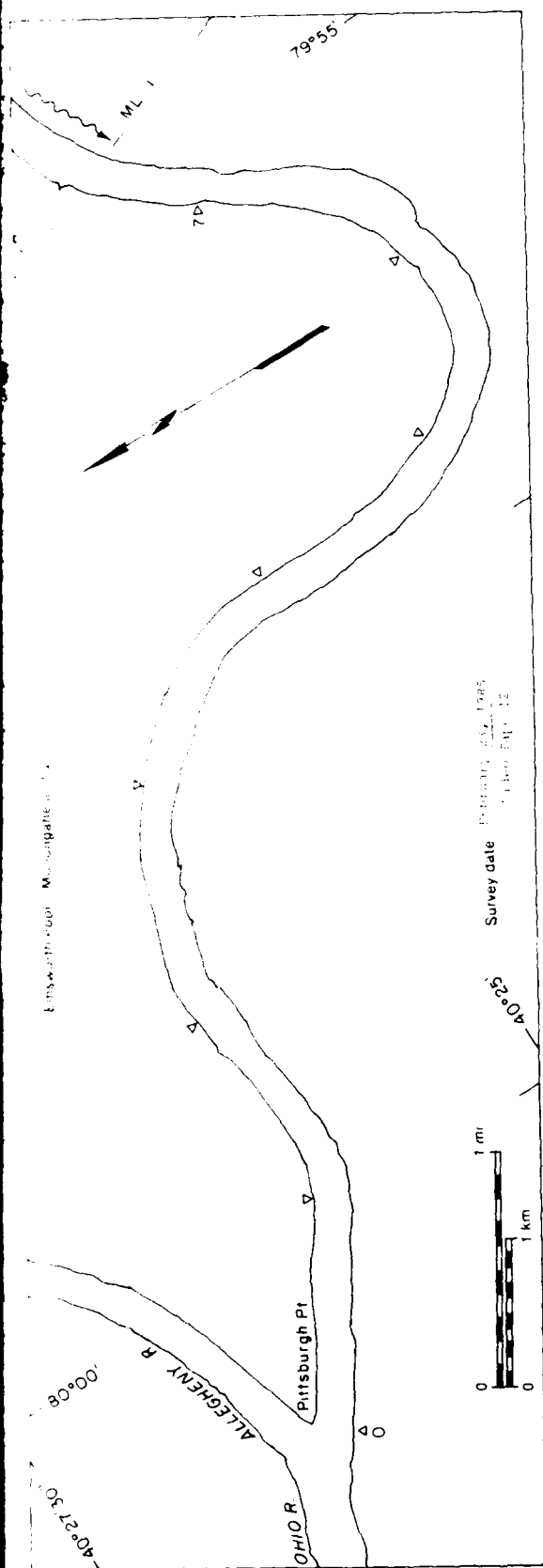
○ Emsworth Pool - Allegheny

Map Area	Surface Concentration (g/l)
Open water	1.17
Shrub cover	NA
Shrub cover with open water areas	NA
Flagged area cover	NA
Flagged area cover with open water areas	NA
Low forest cover	2.10
Low forest cover with open water areas	5
Total Area (m² x 10⁶)	3.27

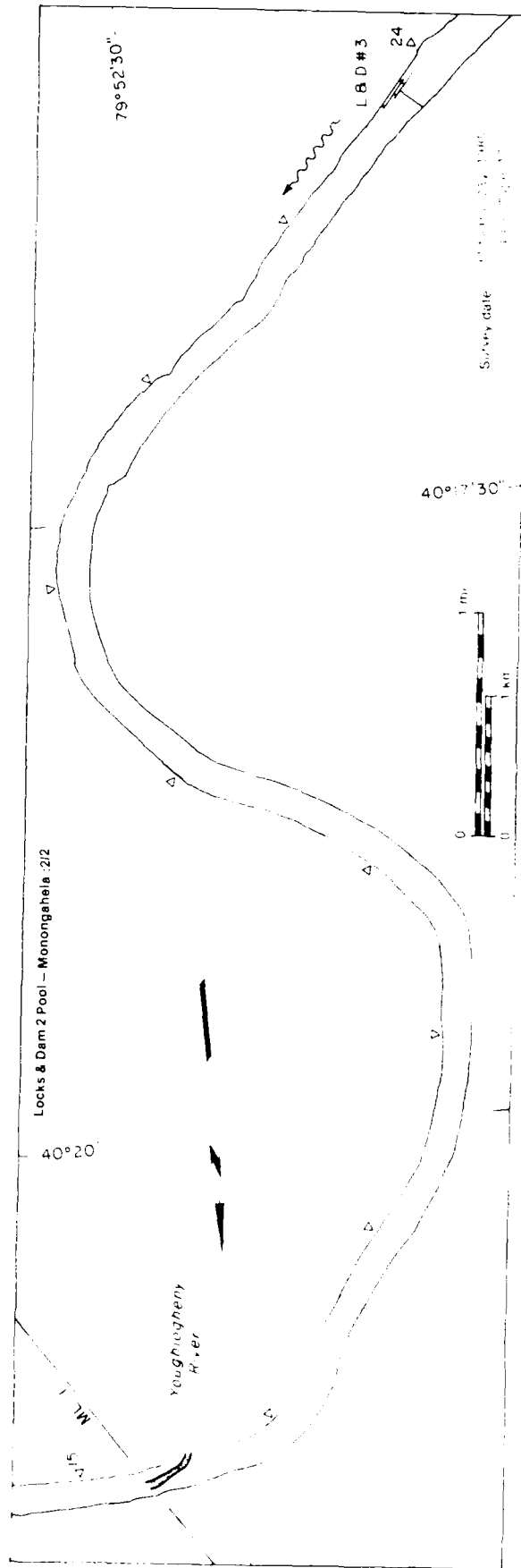
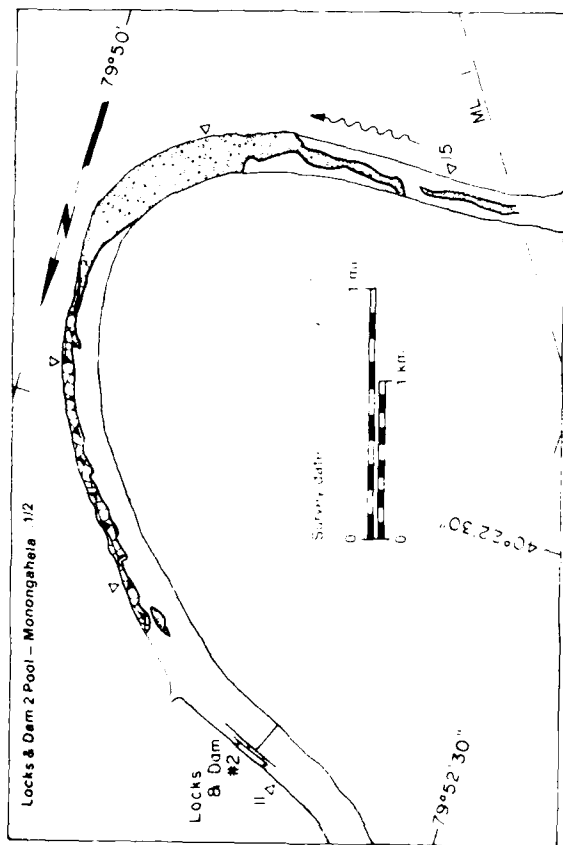
○ Emsworth Pool - Monongahela

Map Area	Surface Concentration (g/l)
Open water	4.73
Shrub cover	NA
Shrub cover with open water areas	NA
Flagged area cover	NA
Flagged area cover with open water areas	NA
Low forest cover	NA
Low forest cover with open water areas	NA
Total Area (m² x 10⁶)	4.73





23 February 1985









Locks & Dam 2 Pool - Monongahela

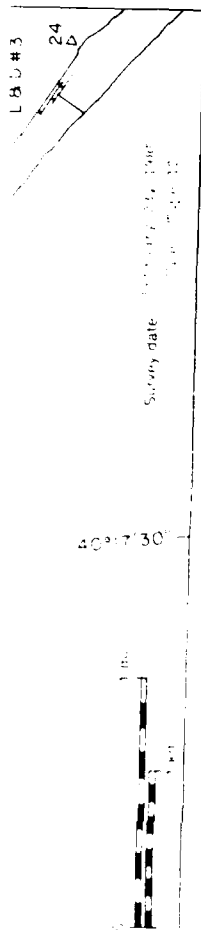
MAP UNITS

MAP UNITS

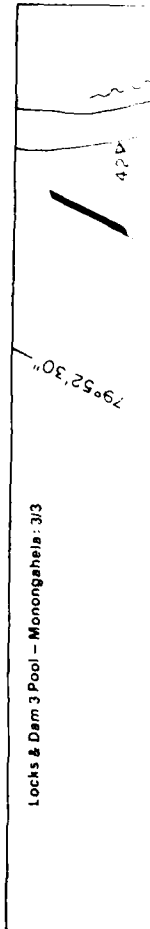
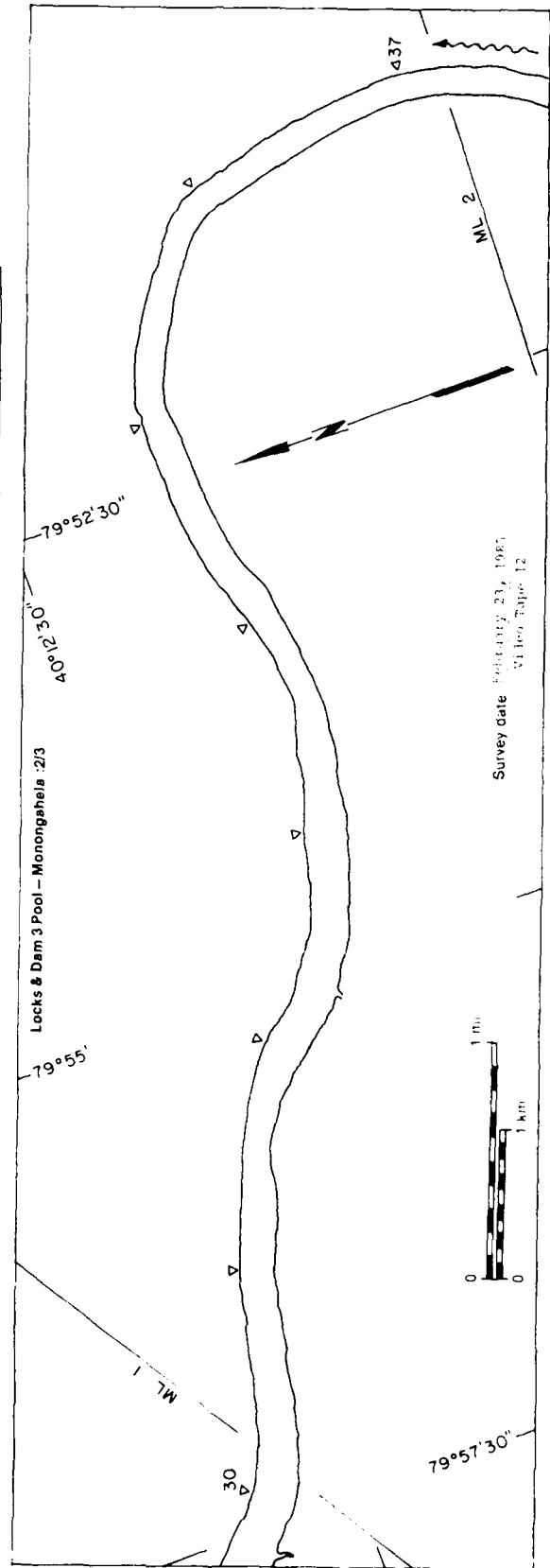
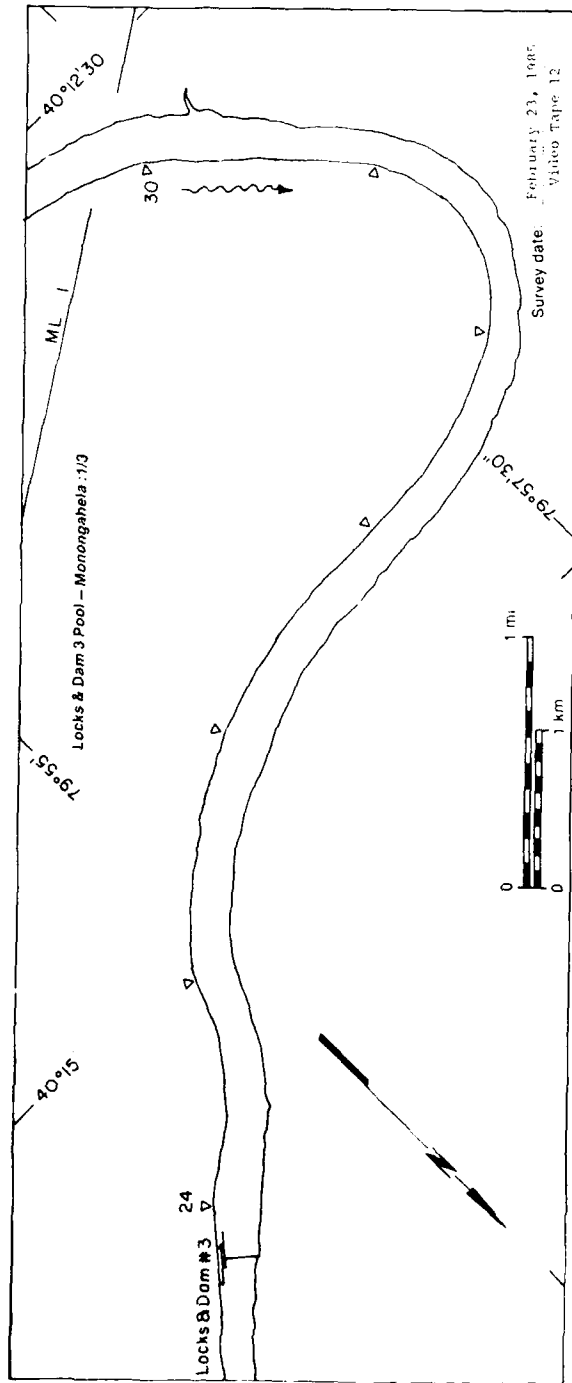
[illegible]

Open water	Solid ice cover	Solid ice cover with open water areas	Fragmented ice cover	Fragmented ice cover with open water areas	Ice like "C" Fractions and "D"
					
4.09	--	--	--	3.17	0.51
NA	NA	--	NA	80	10
					4.77

100

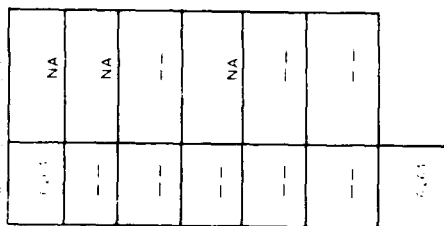
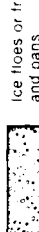
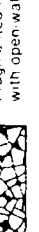
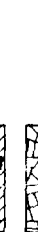
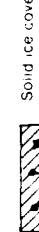
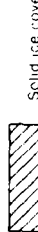
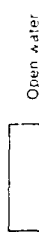
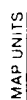
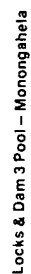
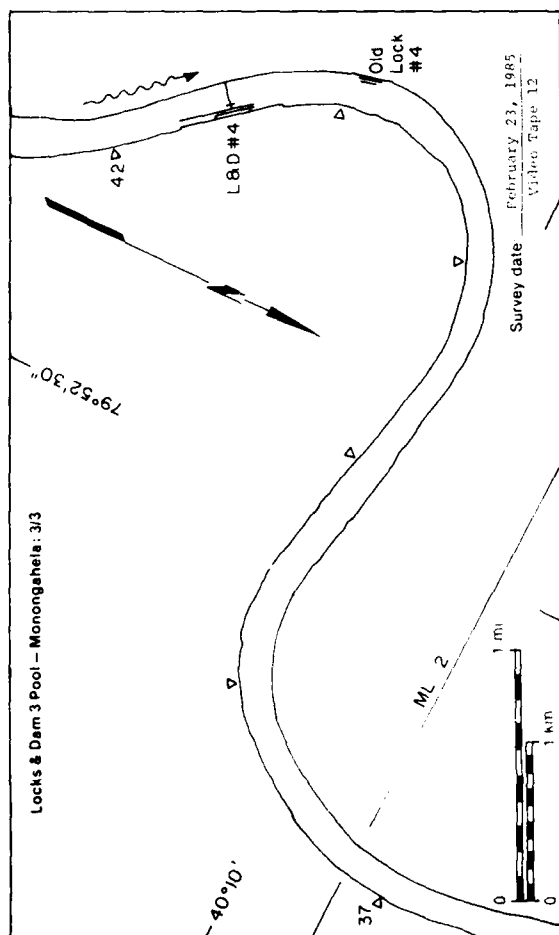


23 February 1985



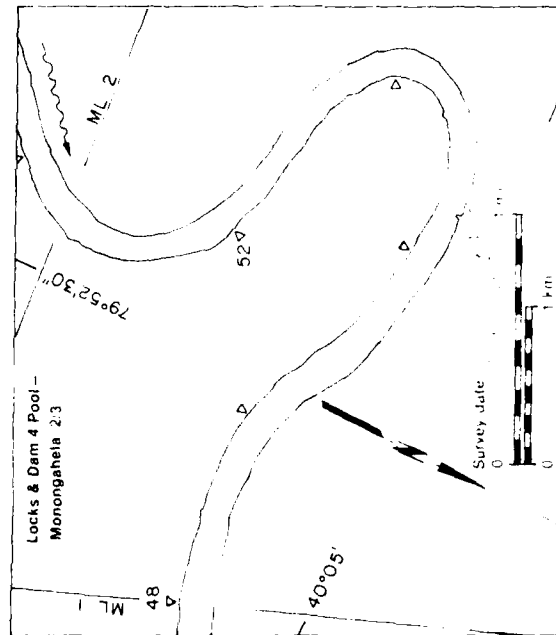
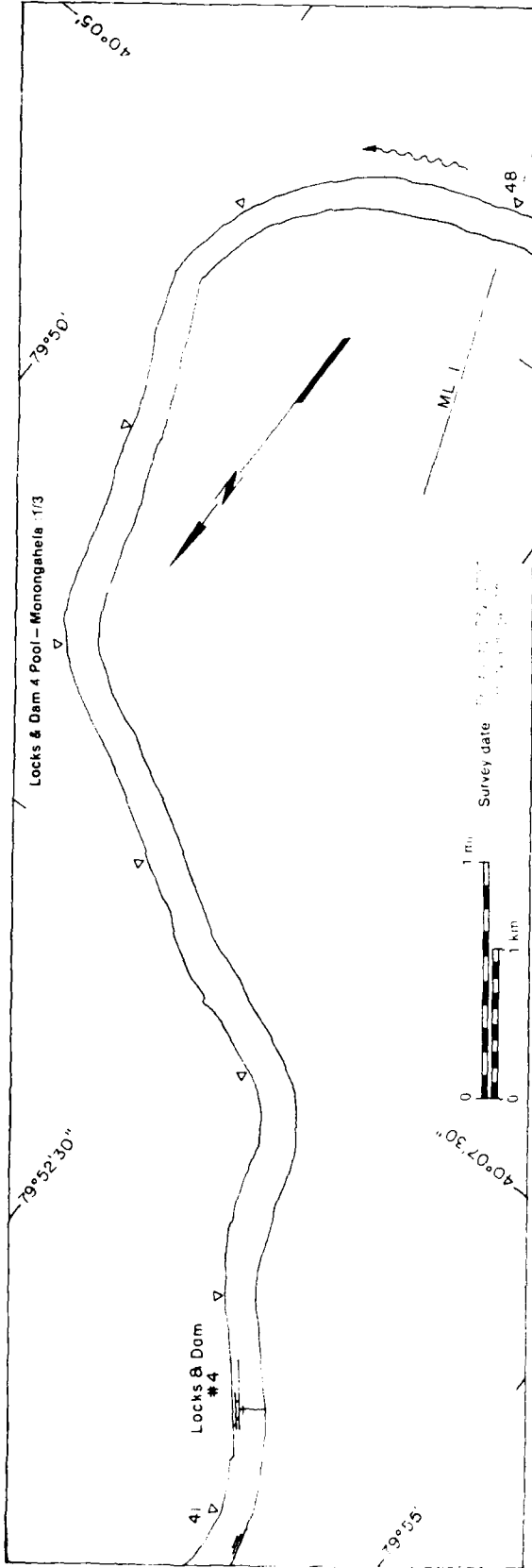
Locks & Dam 3 Pool - Monongahela

MAP 1015



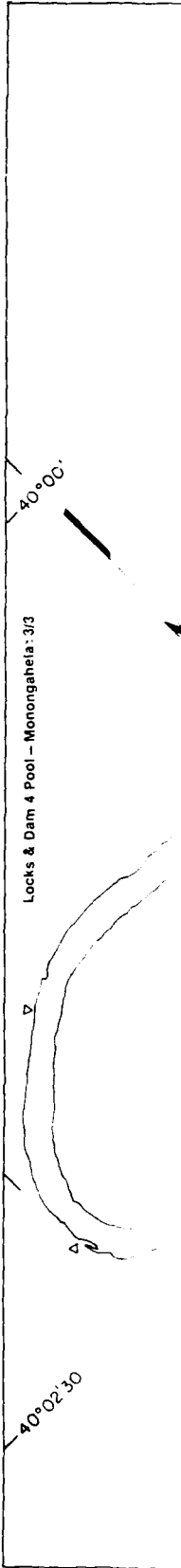
Total Area 100 x 10⁶

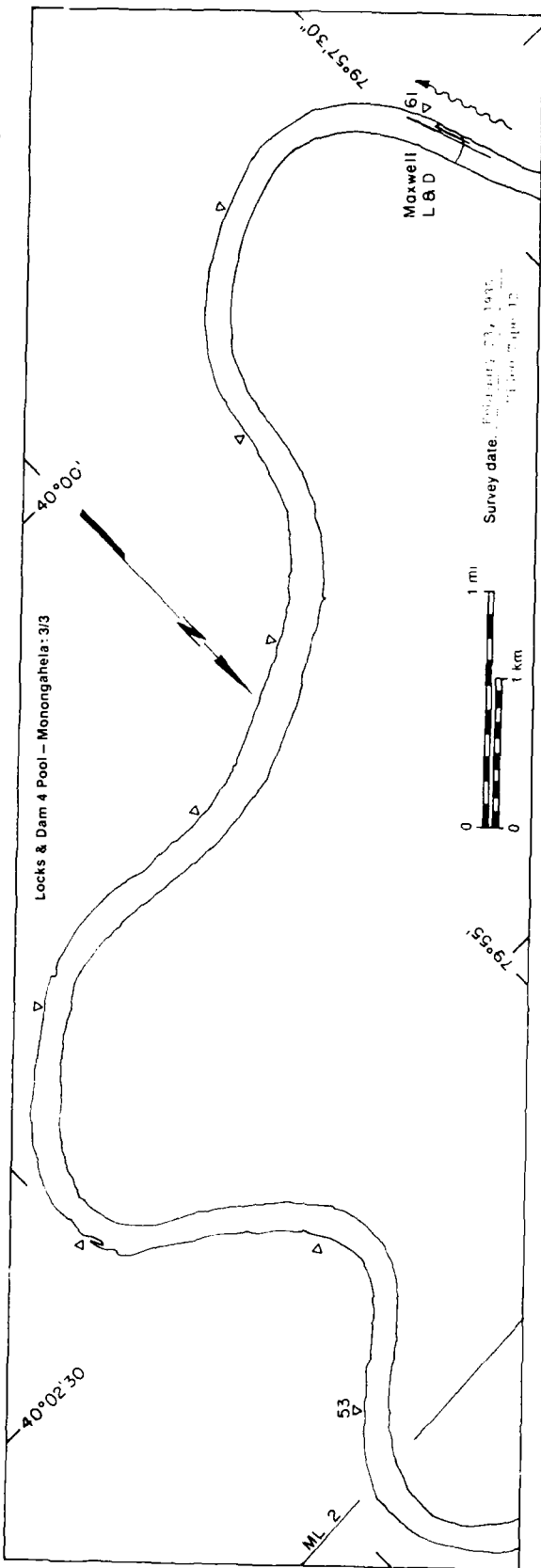
23 February 1985



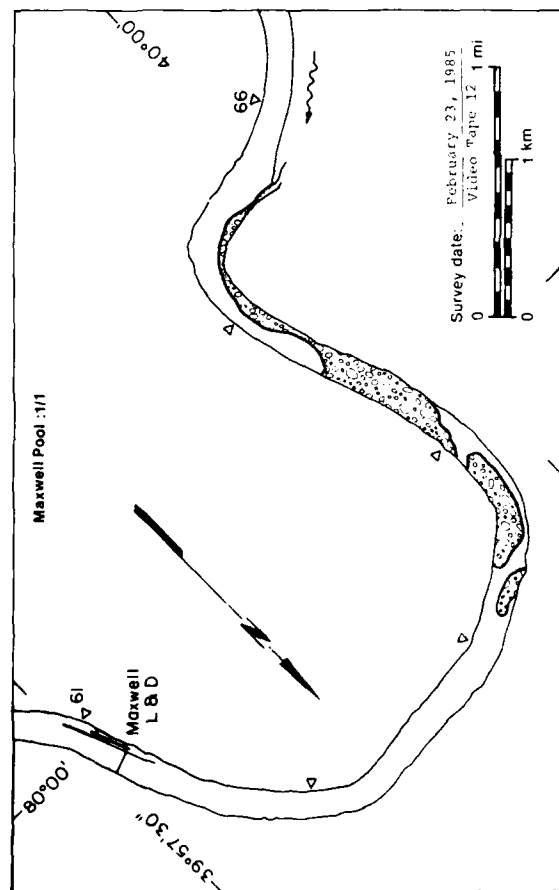
Locks & Dam 4 Pool - Monongahela

MAP UNITS	Scale	Symbol
Open water	NA	—
Solid ice cover	NA	—
Solid ice cover with open water areas	—	—
Fragmented ice cover	NA	—
Fragmented ice cover with open water areas	—	—
Ice cover of 1/2" thick and less	—	—





23 February 1985



Maxwell Pool

MAP UNITS

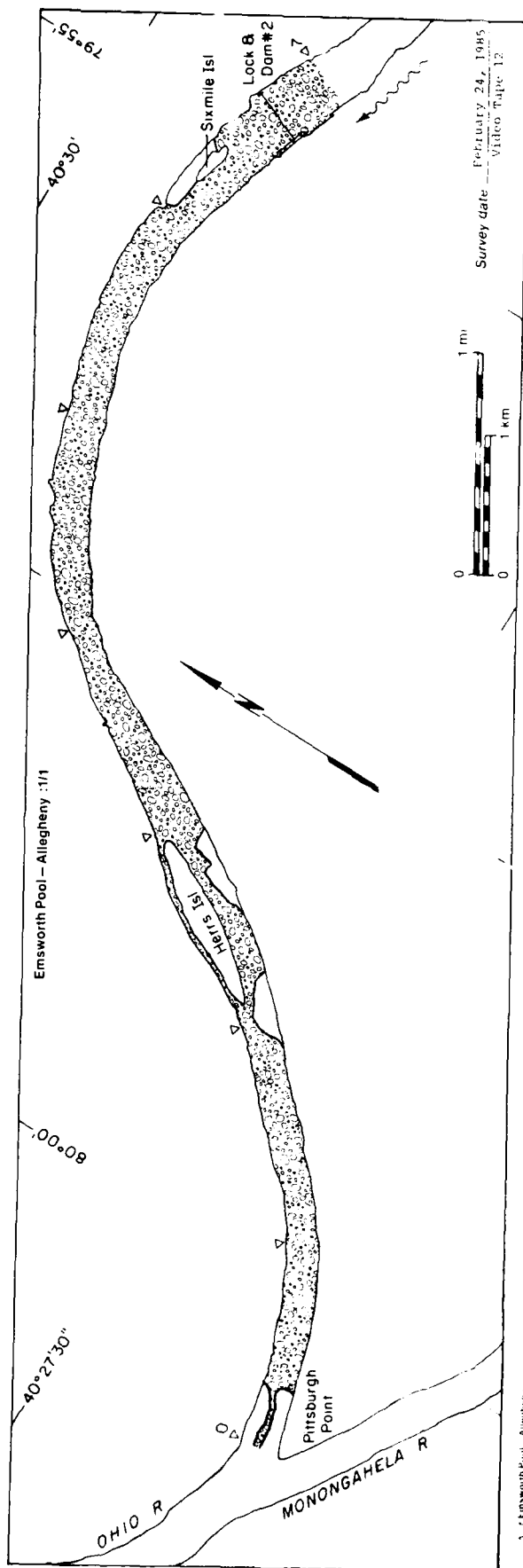
	Open water
	Solid ice cover
	Solid ice cover with open water areas
	Fragmented ice cover
	Fragmented ice cover with open water areas
	Ice floes or frazil slush and pans

Area, $(m^2 \times 10^6)$

1.12	NA
--	NA
--	--
--	NA
--	--
0.44	c
1.56	

Total Area ($m^2 \times 10^6$)

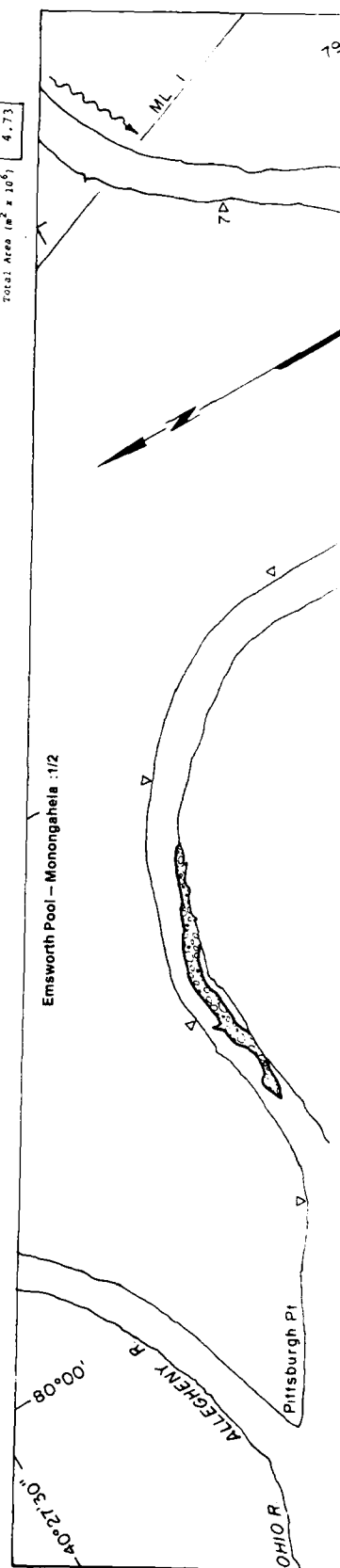
24 February 1985



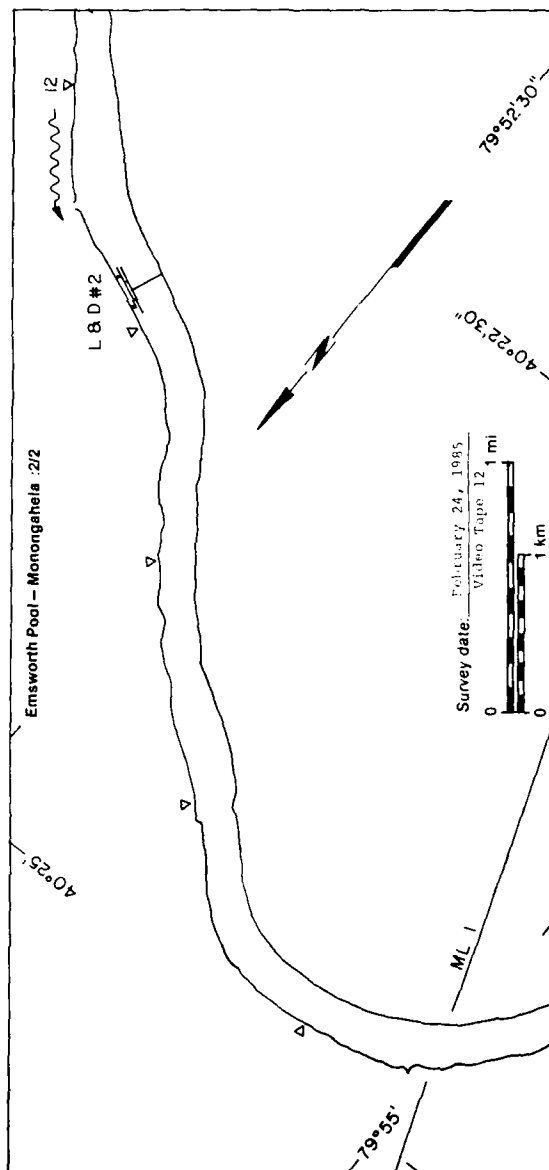
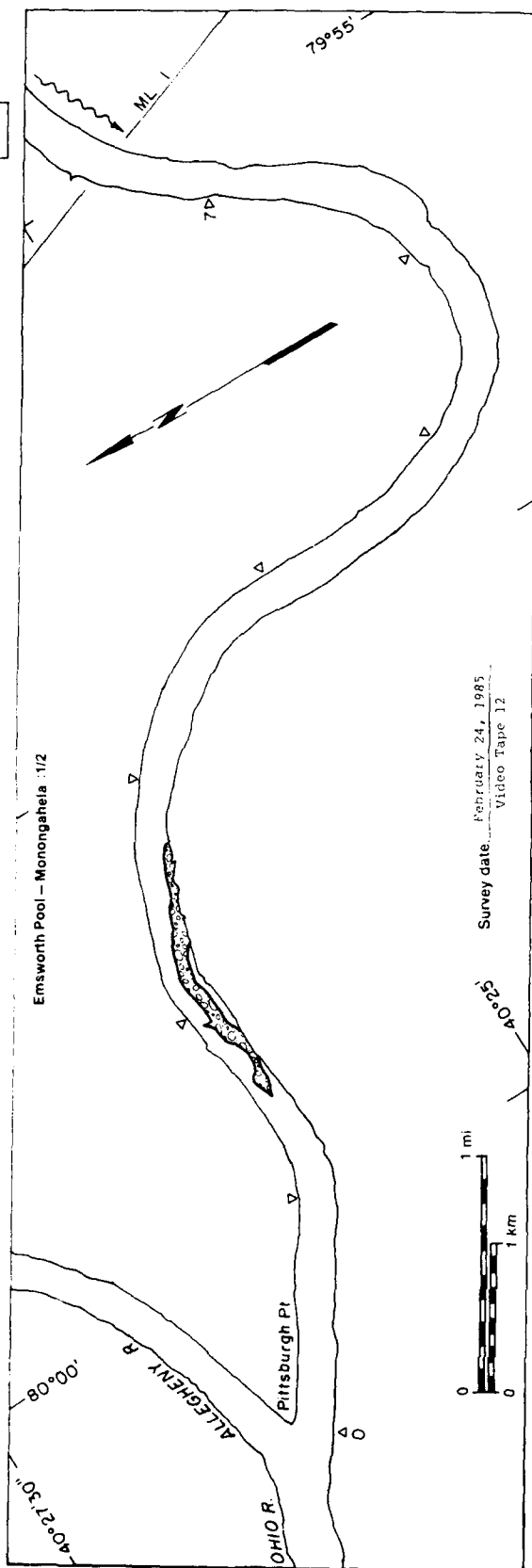
2. Emsworth Pool - Monongahela

Map Unit	Area (m ² x 10 ⁶)	Surface Contamination
Open water	4.56	1.0
Silt & sand	---	1.4
Shrub & trees with open water areas	---	---
Emergent wetland	---	1.4
Highly forested wetland through water areas	---	---
Shrub & trees	0.17	1.0
Total Area (m² x 10⁶)	4.73	

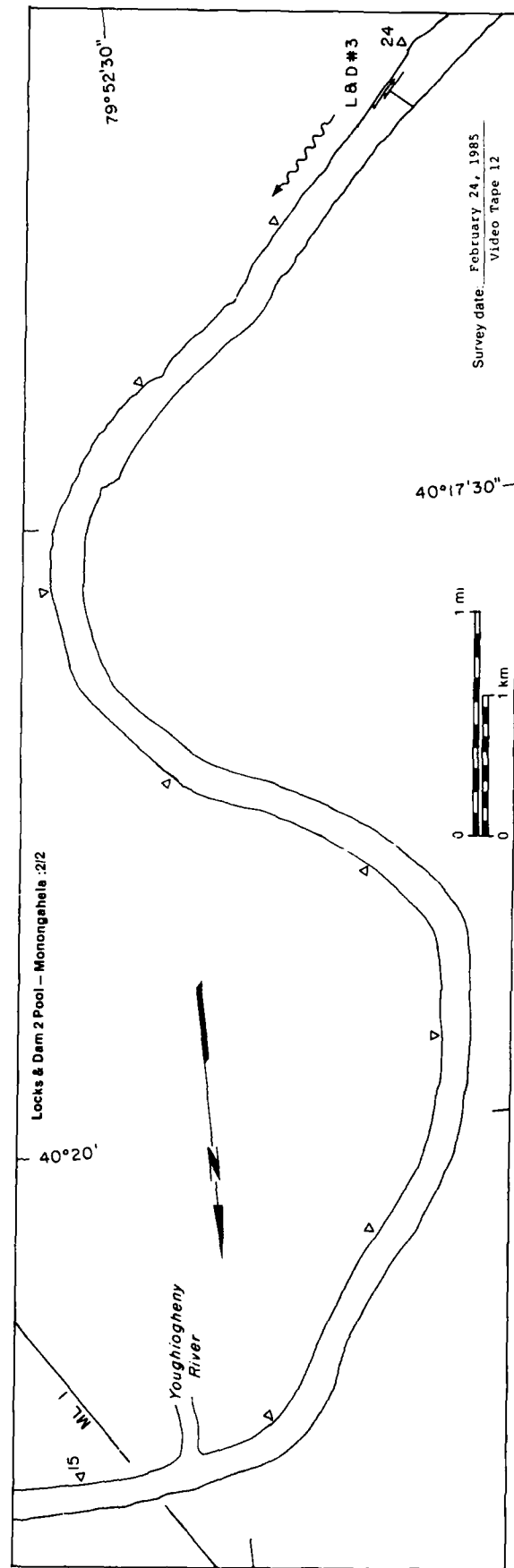
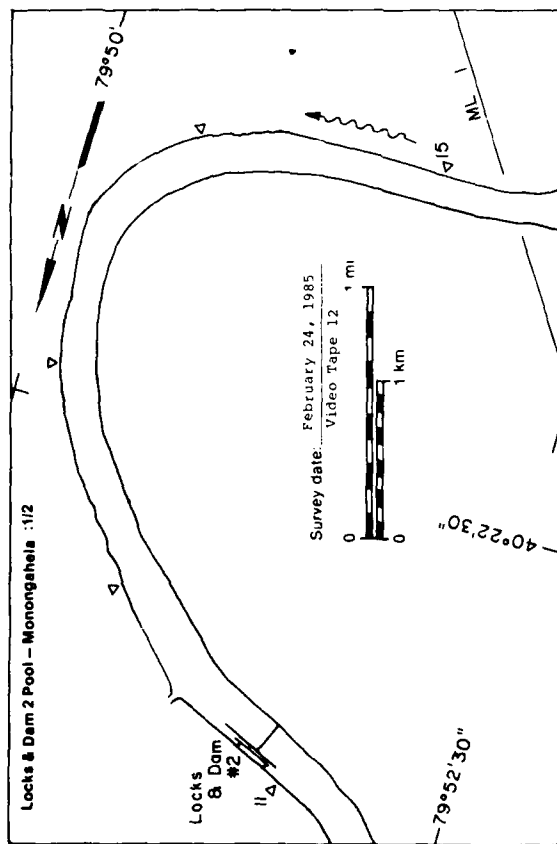
Map Unit	Area (m ² x 10 ⁶)	Surface Contamination
Open water	0.17	1.0
Silt & sand	---	---
Shrub & trees with open water areas	---	1.4
Emergent wetland	---	---
Highly forested wetland through water areas	---	---
Shrub & trees	1.07	1
Total Area (m² x 10⁶)	1.27	



Initial Area (sq. x 10⁶) 4.73



24 February 1985



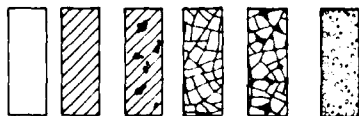
Locks & Dam 2 Pool - Monongahela

MAP UNITS

Scale
1 inch = 1 mile
1 cm = 1 km

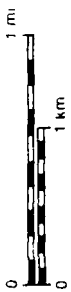
Locks & Dam 2 Pool - Monongahela

MAP UNITS



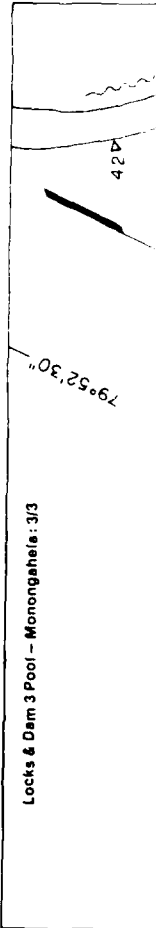
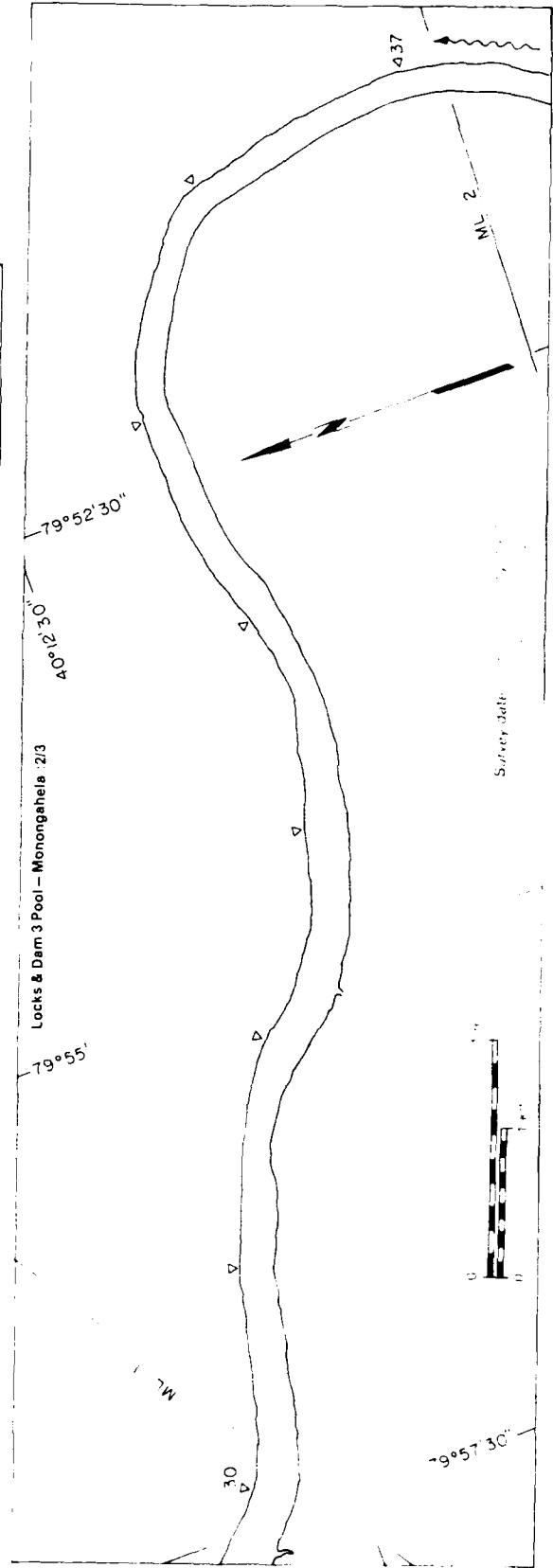
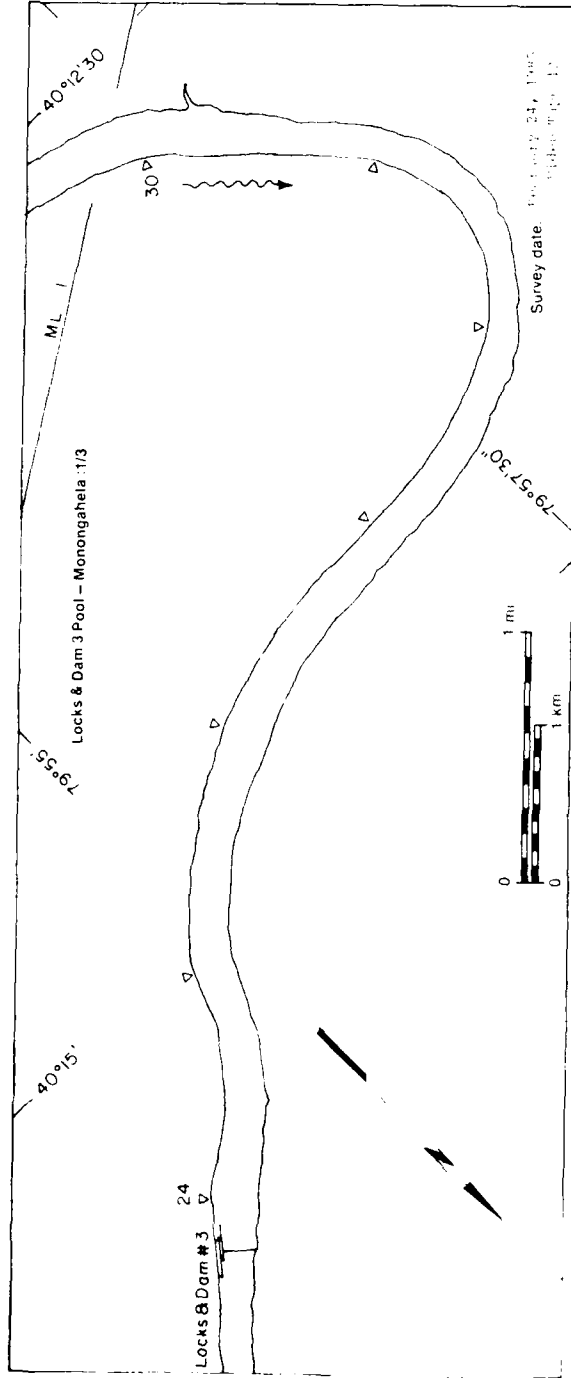
MAP UNITS	Area 6 ($\times 10^6$)	Surface concentration (%)
Open water	4.77	NA
Solid ice cover	--	NA
Solid ice cover with open water areas	--	--
Fragmented ice cover	--	NA
Fragmented ice cover with open water areas	--	--
Ice floes or frazil slush and pans	--	--
Total Area ($\times 10^6$)	4.77	

40°17'30"



Survey date February 24, 1985
Video Tape 12

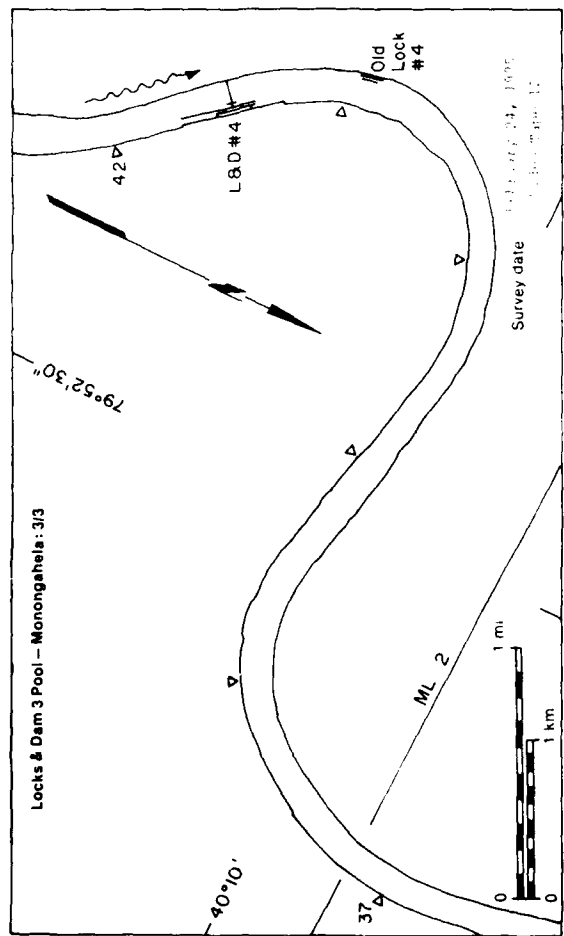
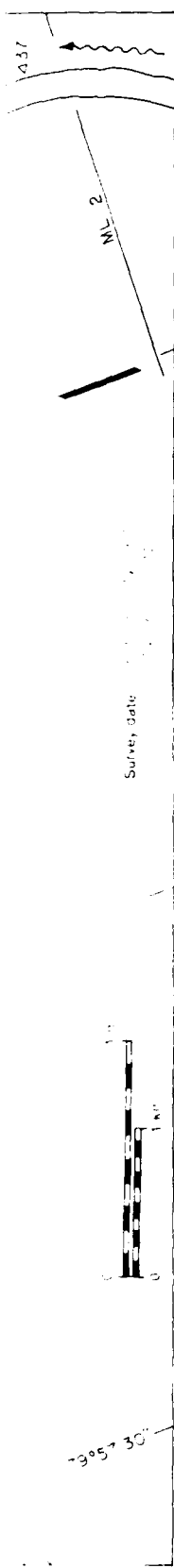
24 February 1985



Locks & Dam 3 Pool - Monongahela

MAU 24, 15

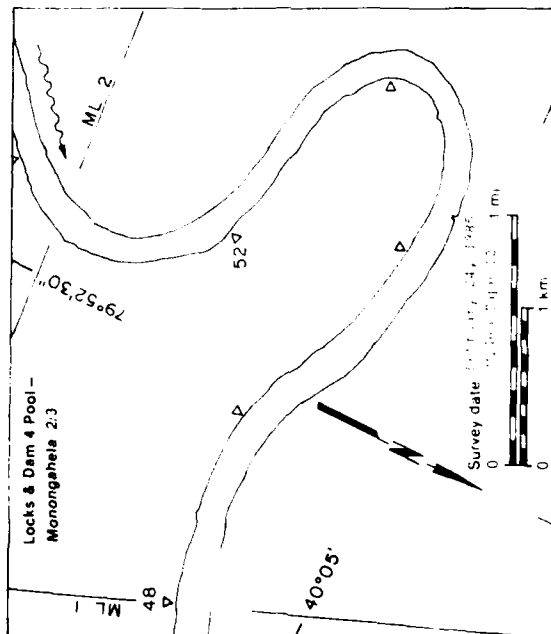
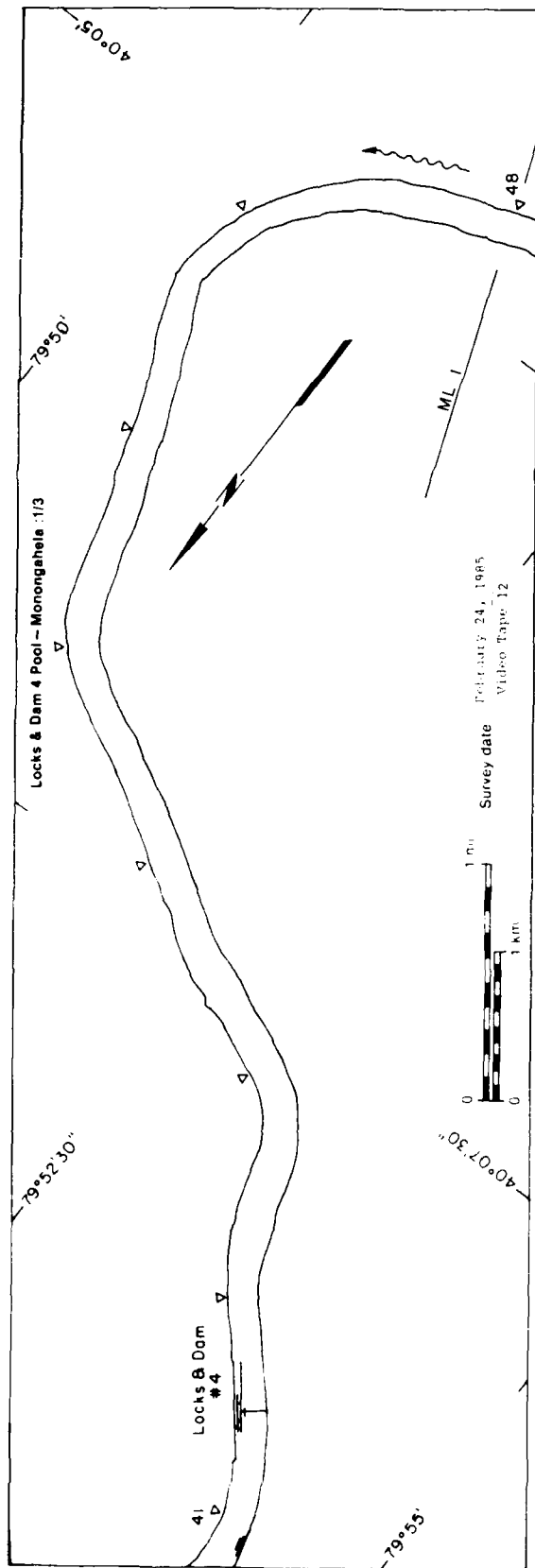
40°



Locks & Dam 3 Pool - Monongahela

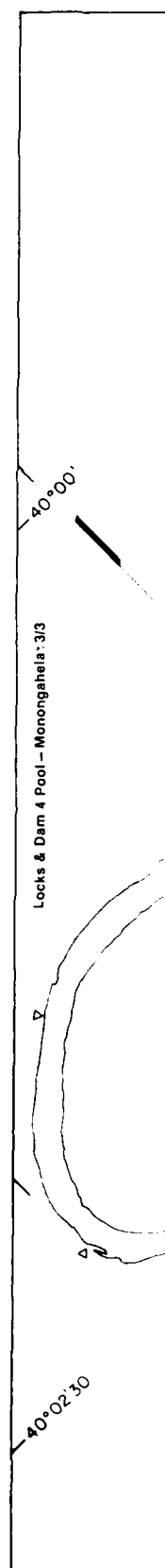
MAP UNITS	Area (ac) x 10 ⁴	Area (km ²) x 10 ⁴
Open water	6.64	NA
Solid ice cover	---	NA
Solid ice cover with open-water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open-water areas	---	---
Ice floes or frazil slush and pans	---	---
	6.64	

24 February 1985



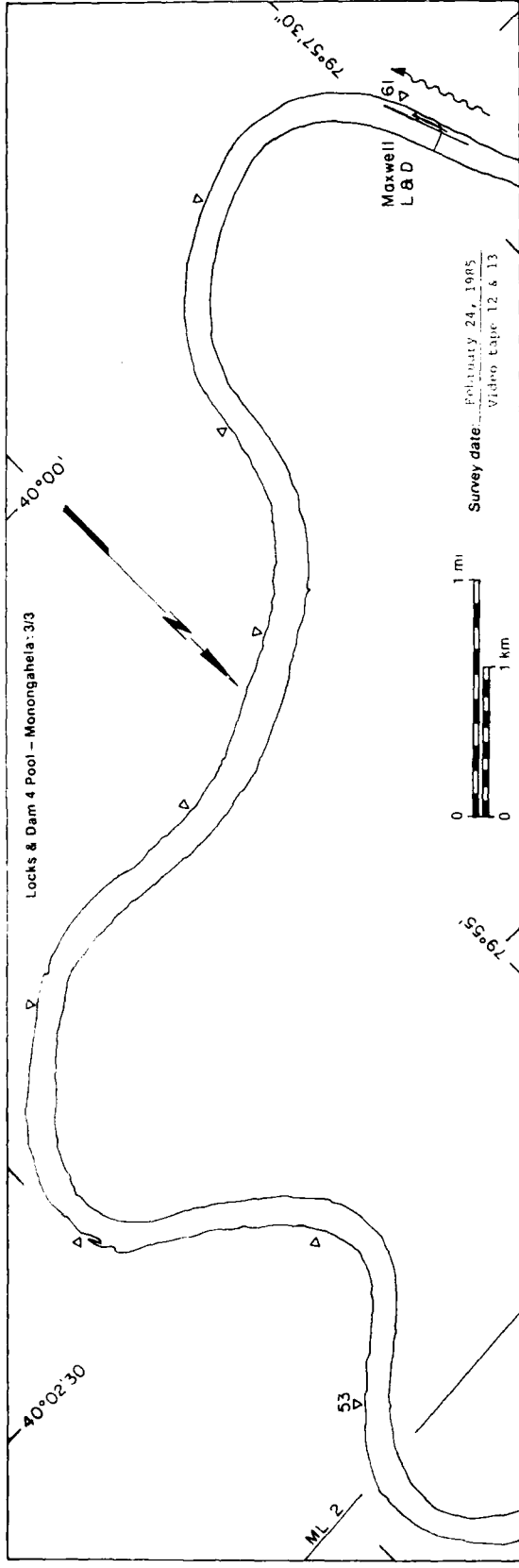
Locks & Dam 4 Pool - Monongahela

MAP UNITS		Area, $\times 10^6$ ($m^2 \times 10^6$)	Surface concentration (%)
	Open water	5.60	NA
	Solid ice cover	---	NA
	Solid ice cover with open-water areas	---	---
	Fragmented ice cover	---	NA
	Fragmented ice cover with open-water areas	---	---
	Ice floes or frazil slush and pans	---	---
Total Area ($m^2 \times 10^6$)		6.60	

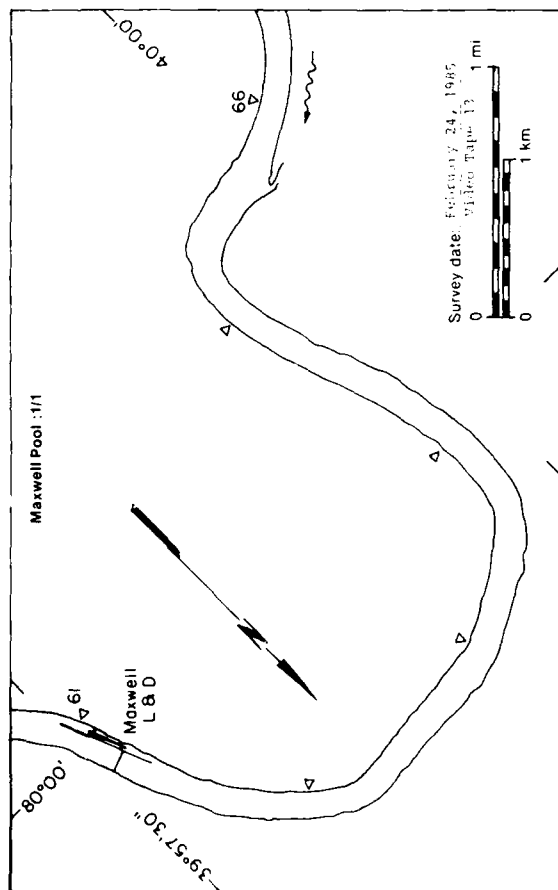


100'

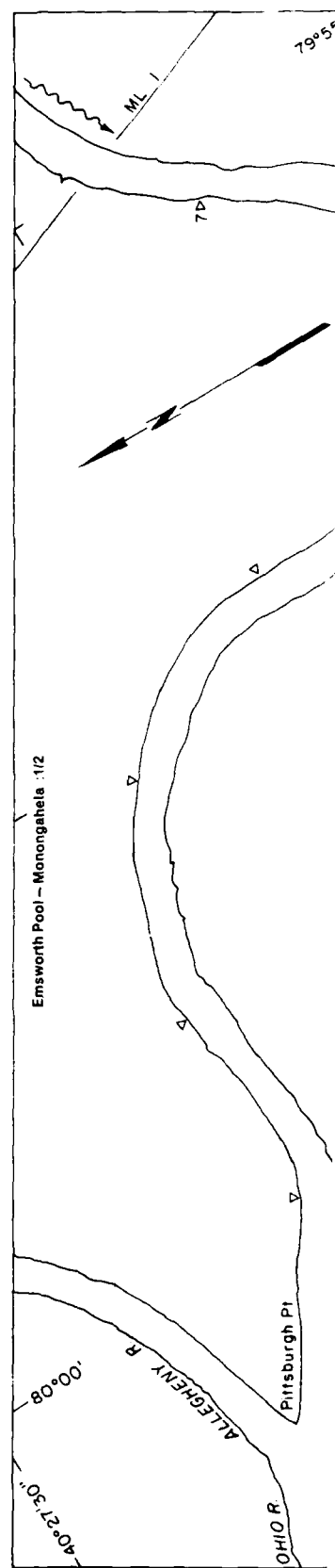
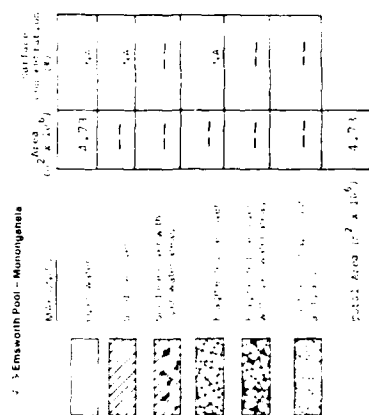
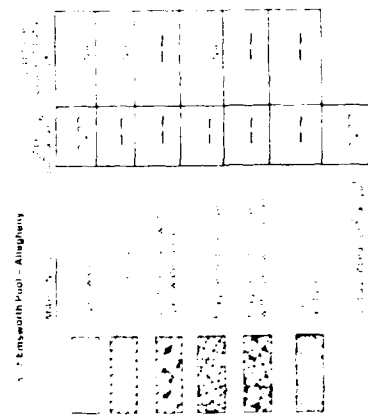
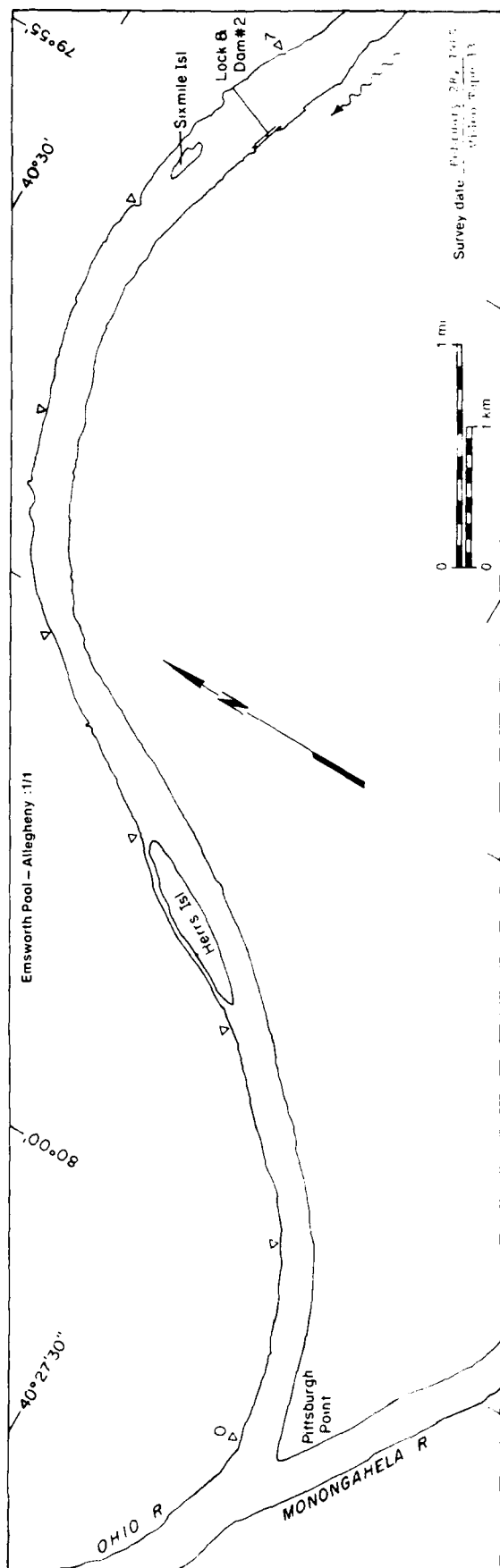
Scale 1:62,500

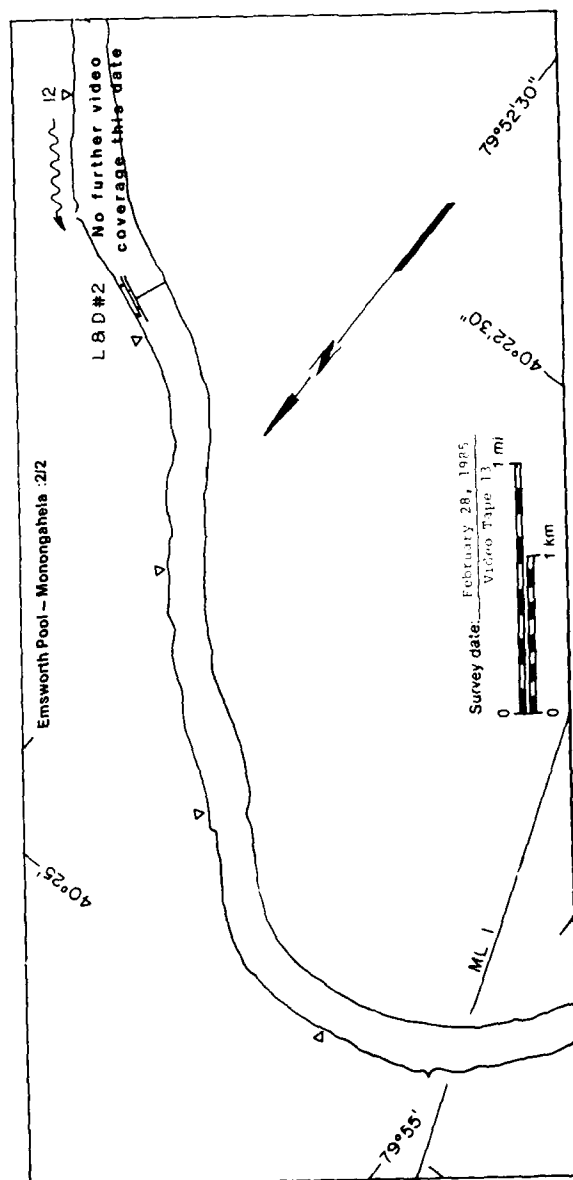
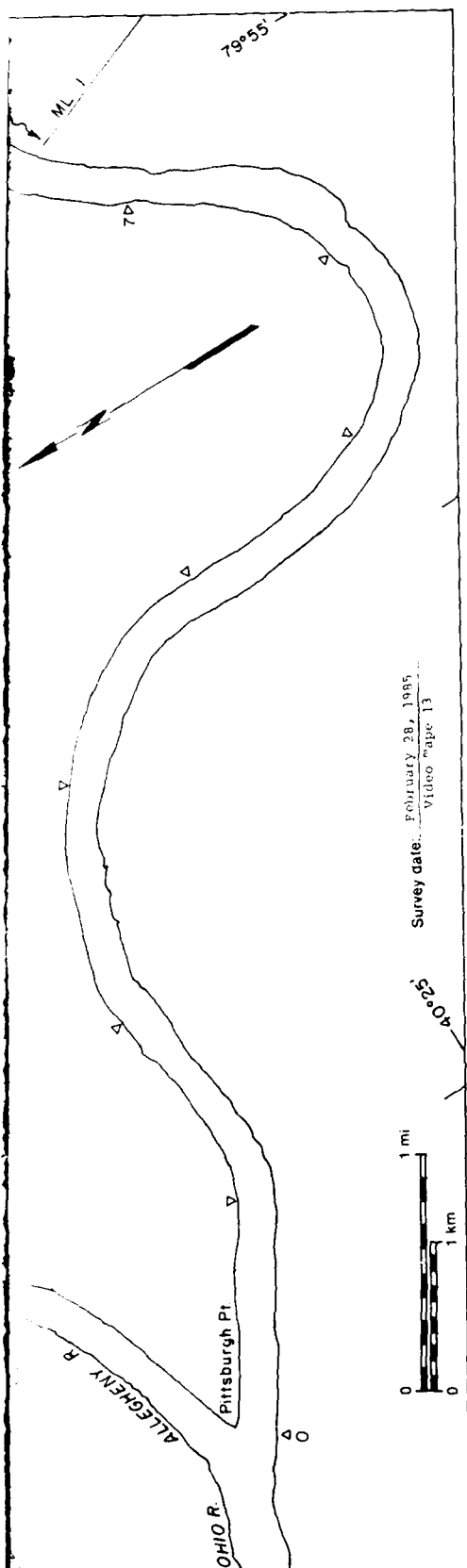


24 February 1985

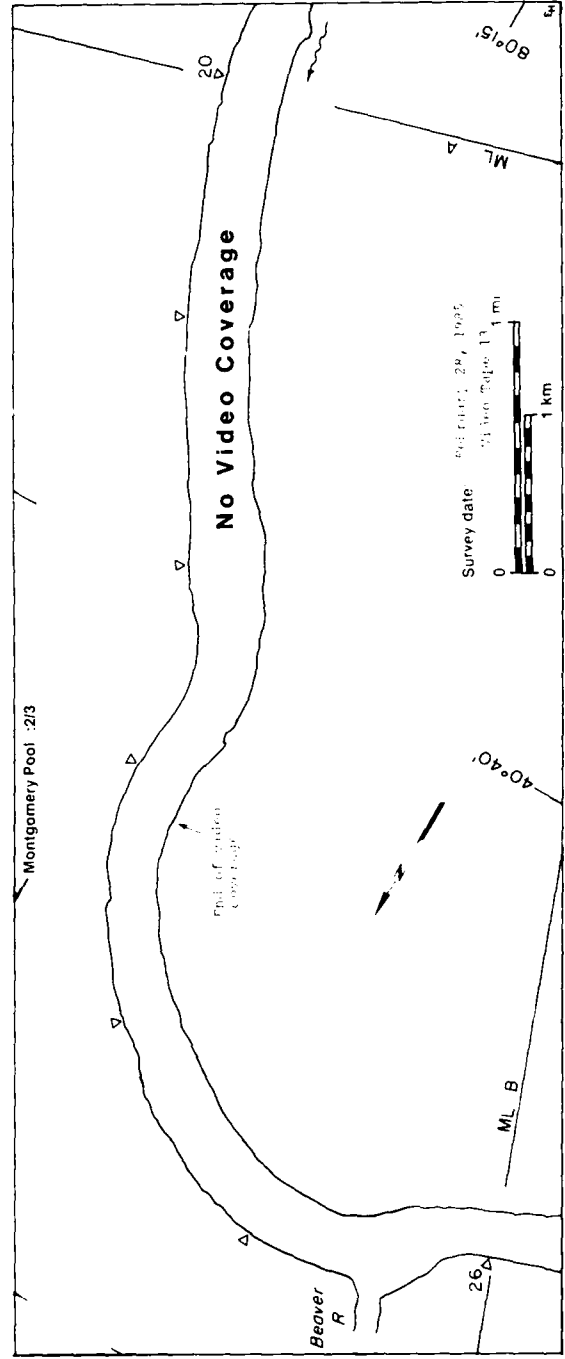
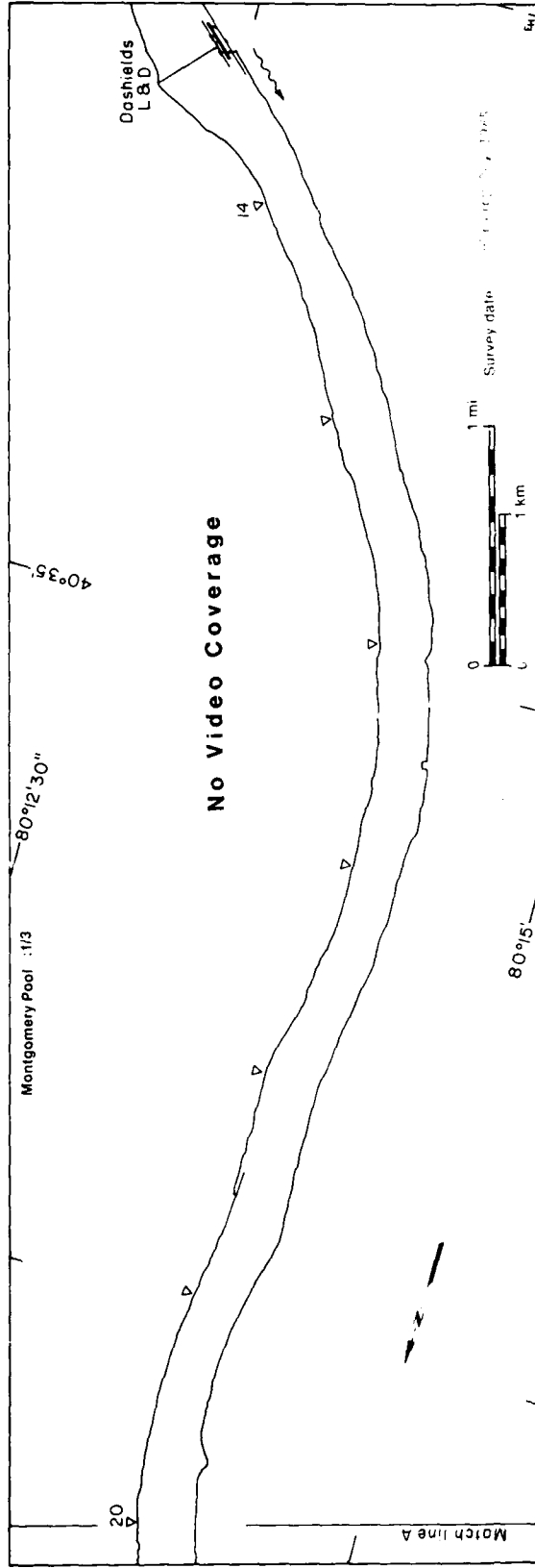


Maxwell Pool MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	1.56	NA
Solid ice cover	---	NA
Solid ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	---	---
Ice floes or frazil slush and pans	---	---
Total Area (m ² x 10 ⁶)	1.56	

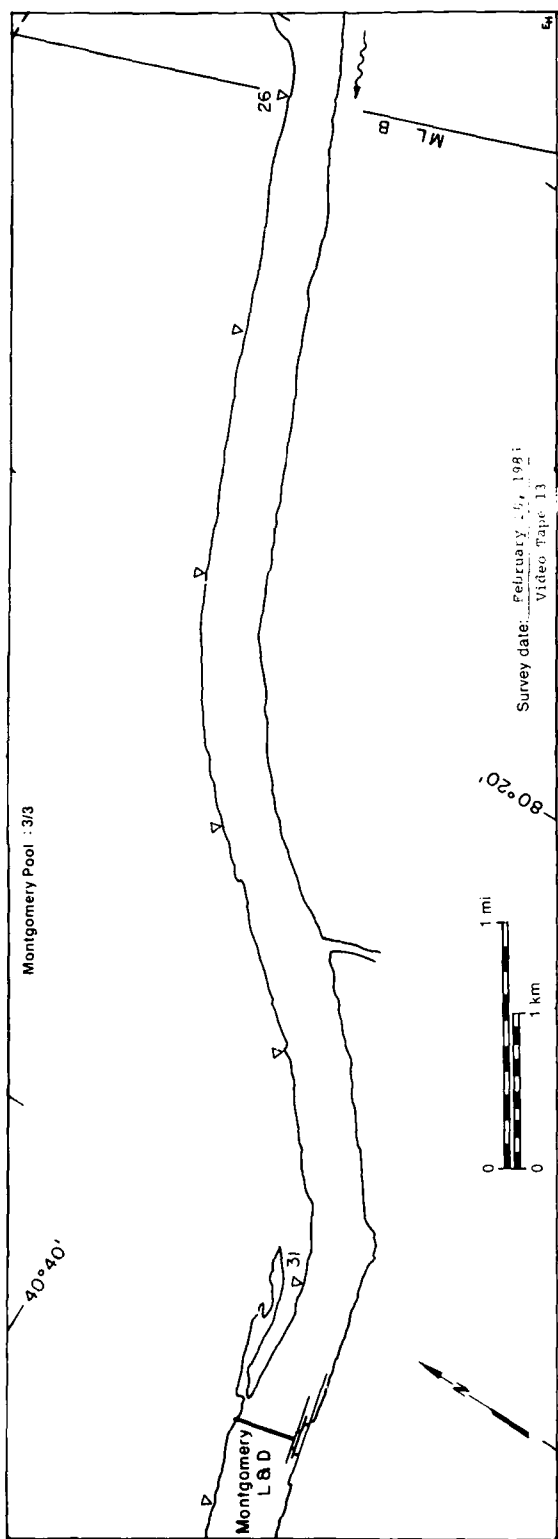




28 February 1985



Montgomery Pool :3/3



Montgomery Pool

MAP UNITS

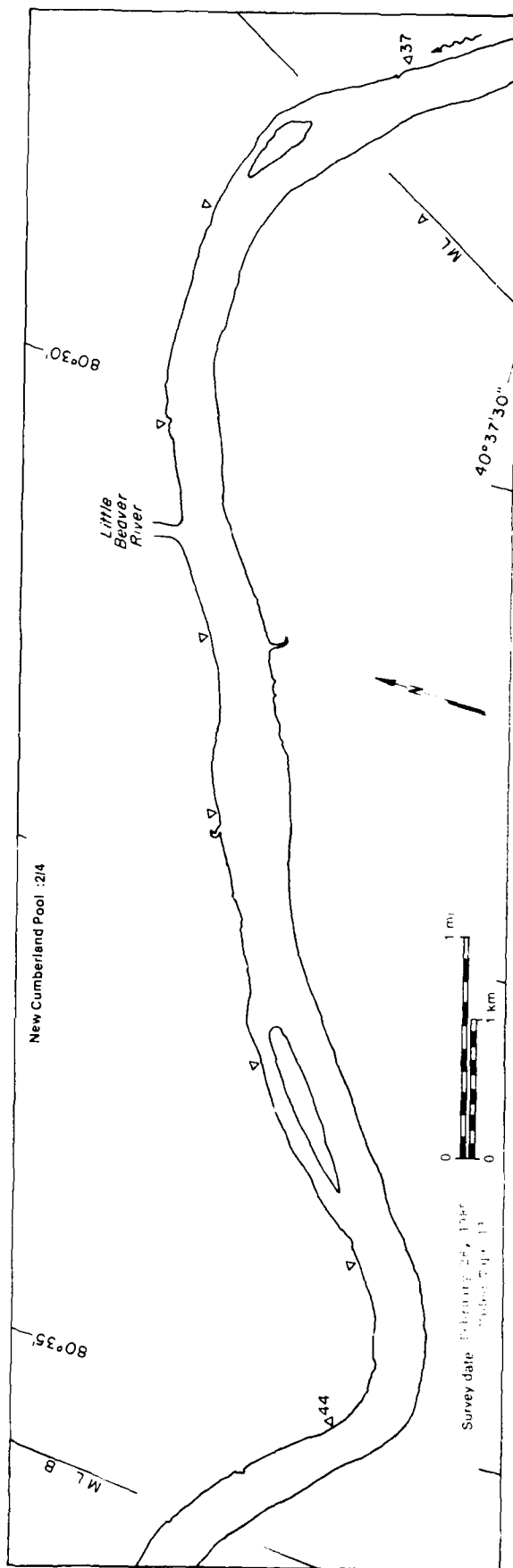
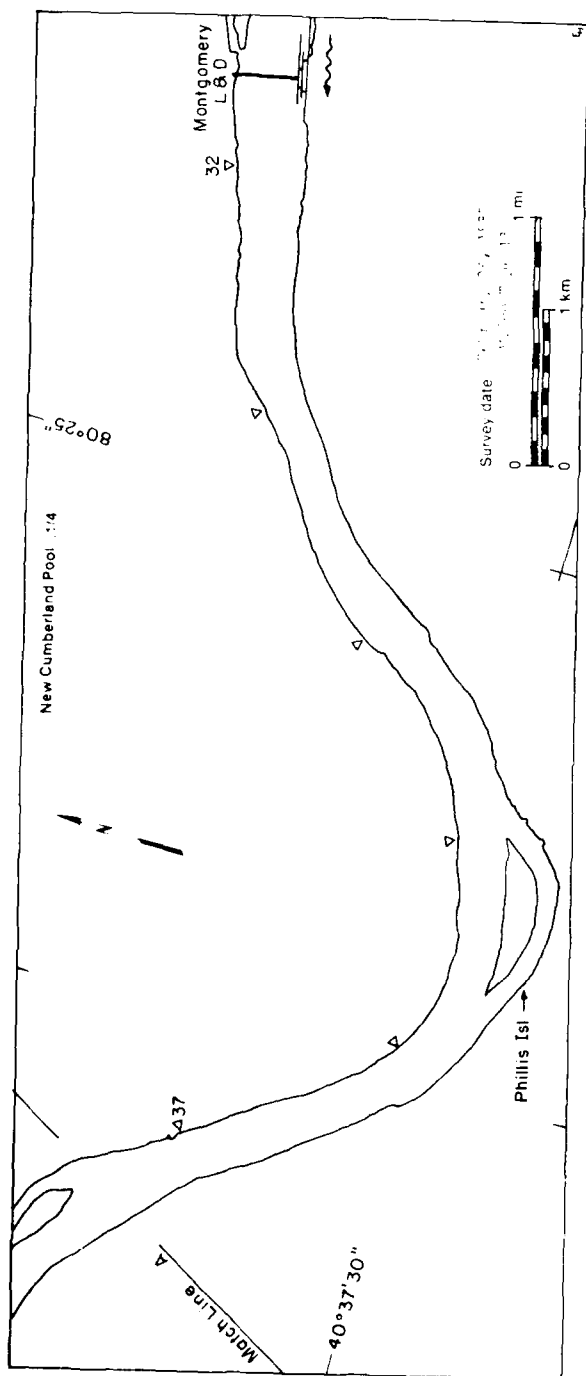
- Open water
- Solid ice cover
- Solid ice cover with open water areas
- Fragmented ice cover
- Fragmented ice cover with open water areas
- Ice floes or frazil slush and pans

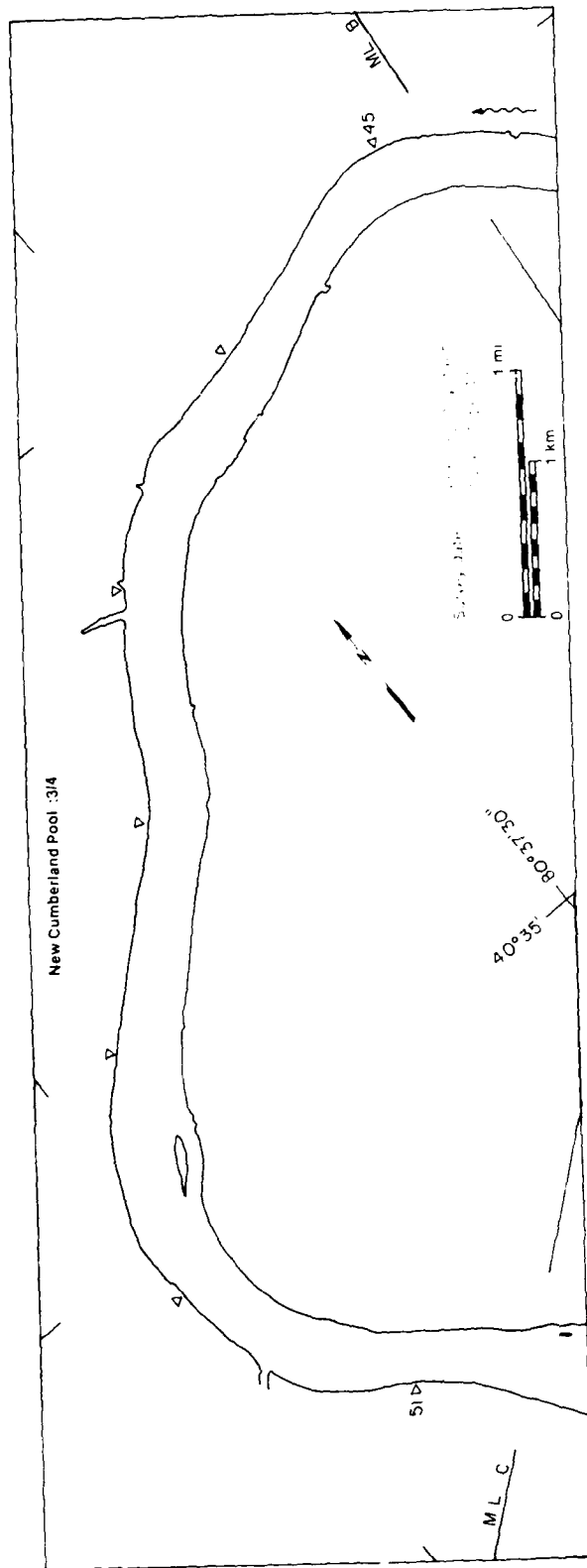
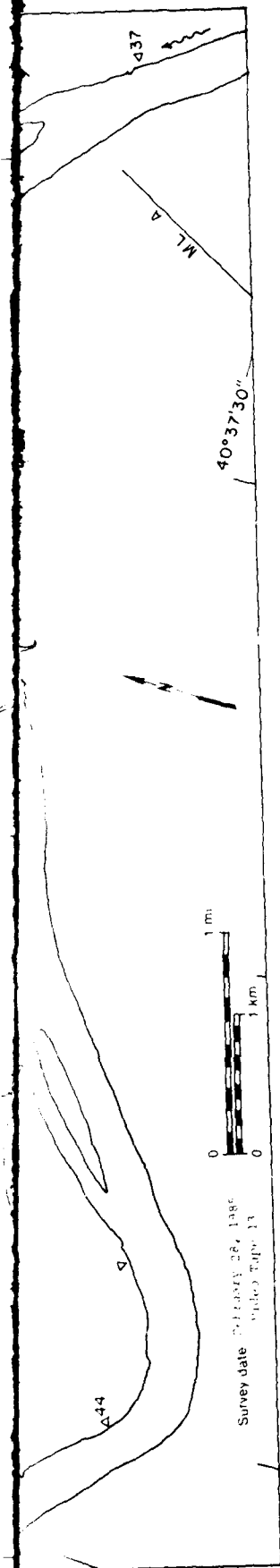
Surface concentration
($10^2 \times 10^6$)

5.30	NA
---	NA
---	---
---	NA
---	---
---	---
11.2*	*Includes 5.97 no video coverage

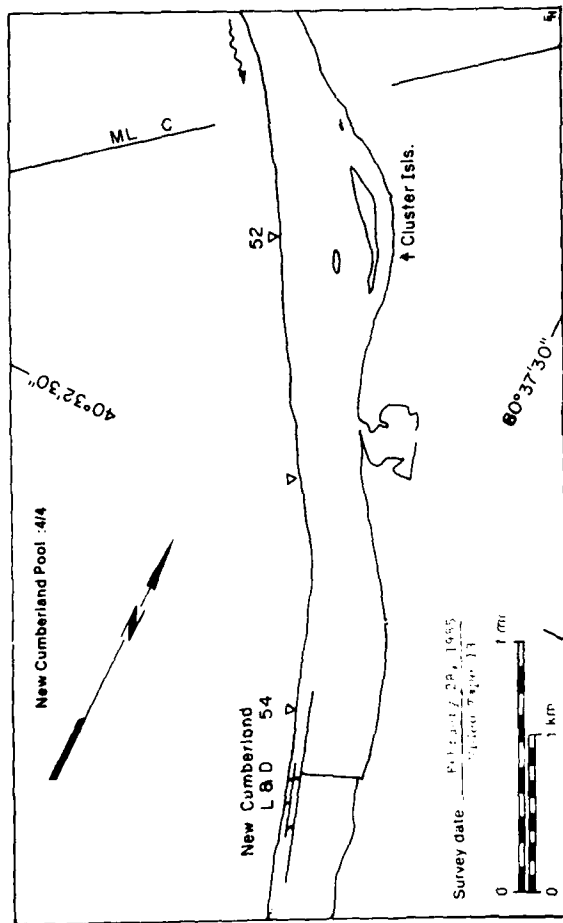
Total Area ($m^2 \times 10^6$)

28 February 1985



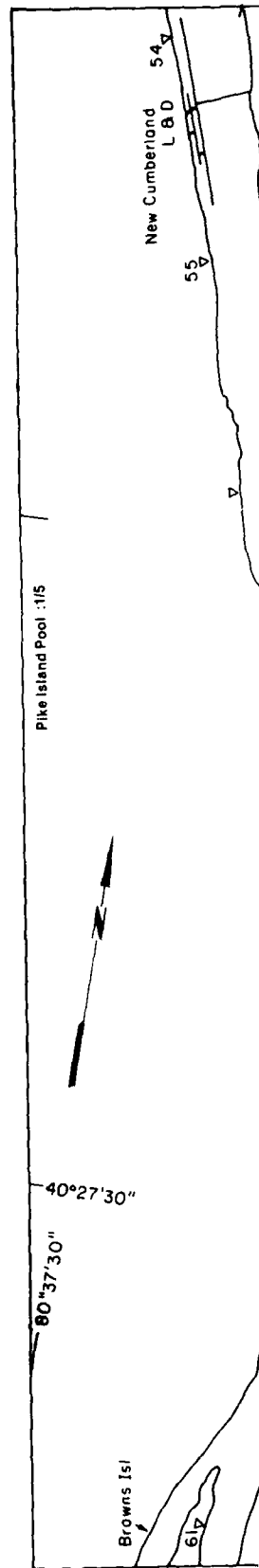


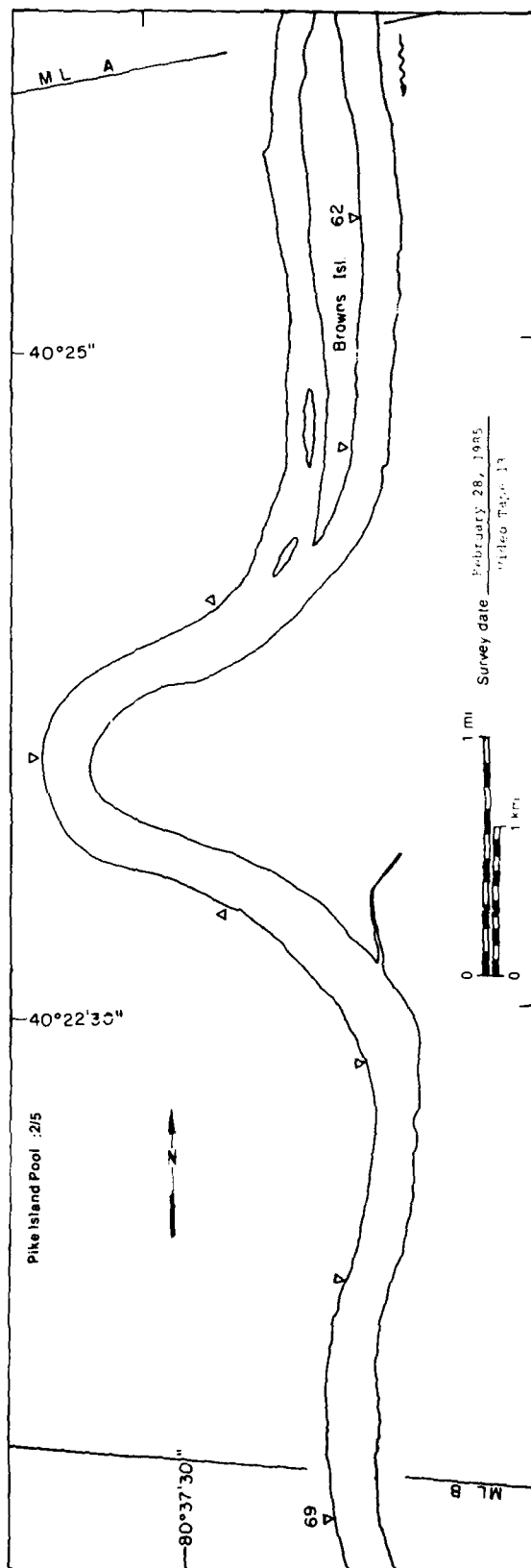
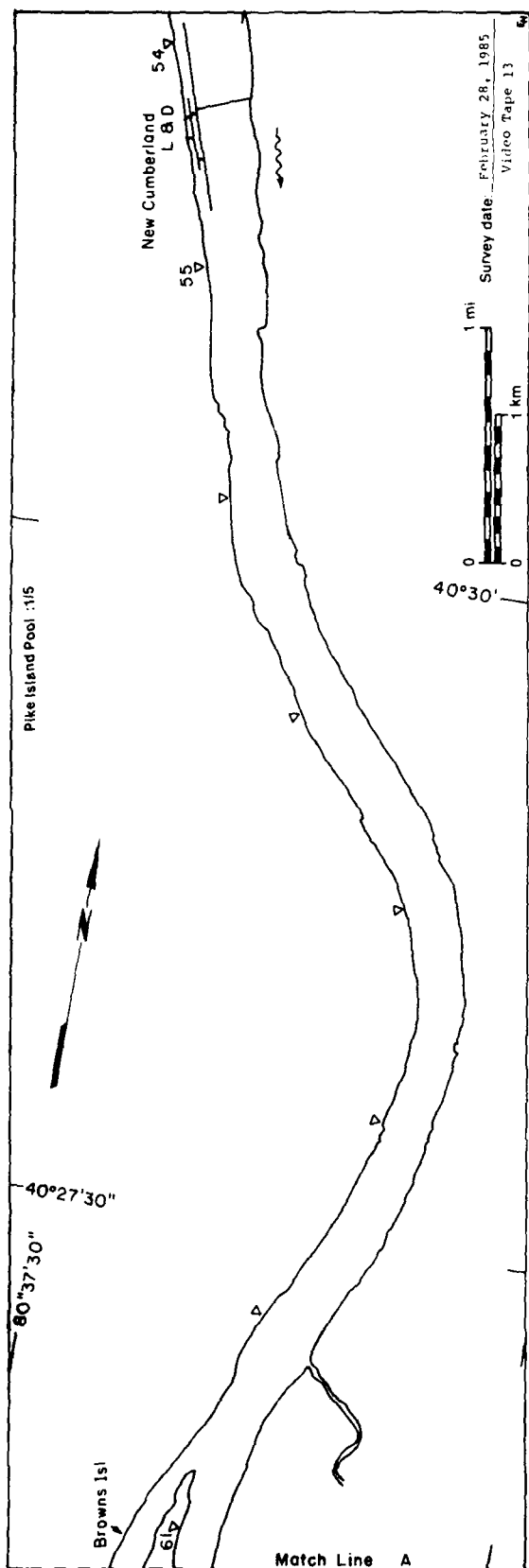
28 February 1985



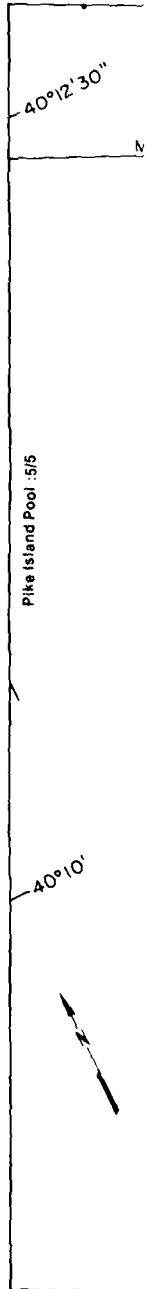
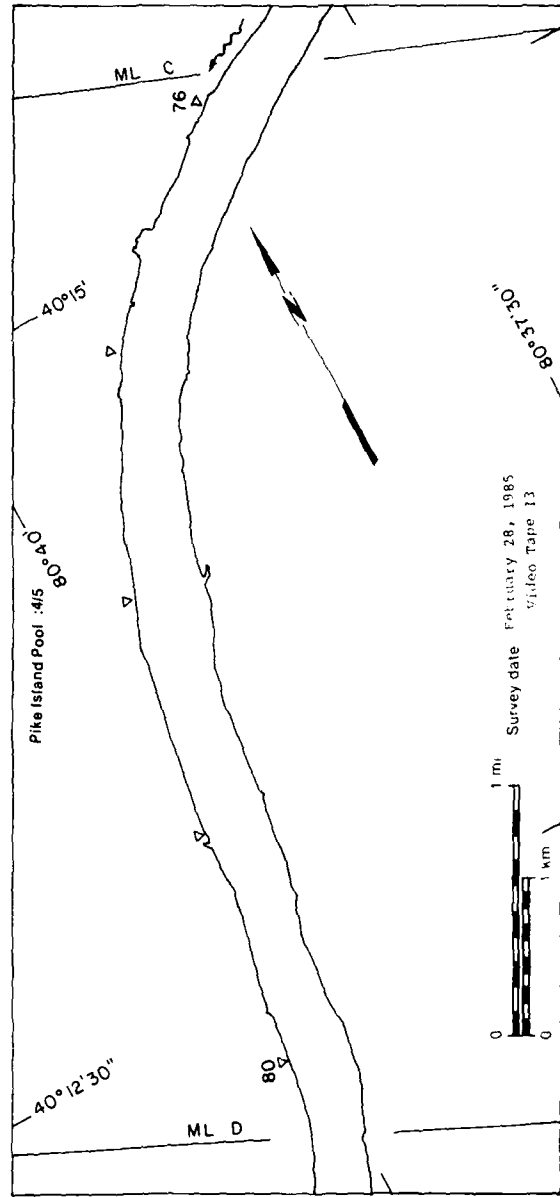
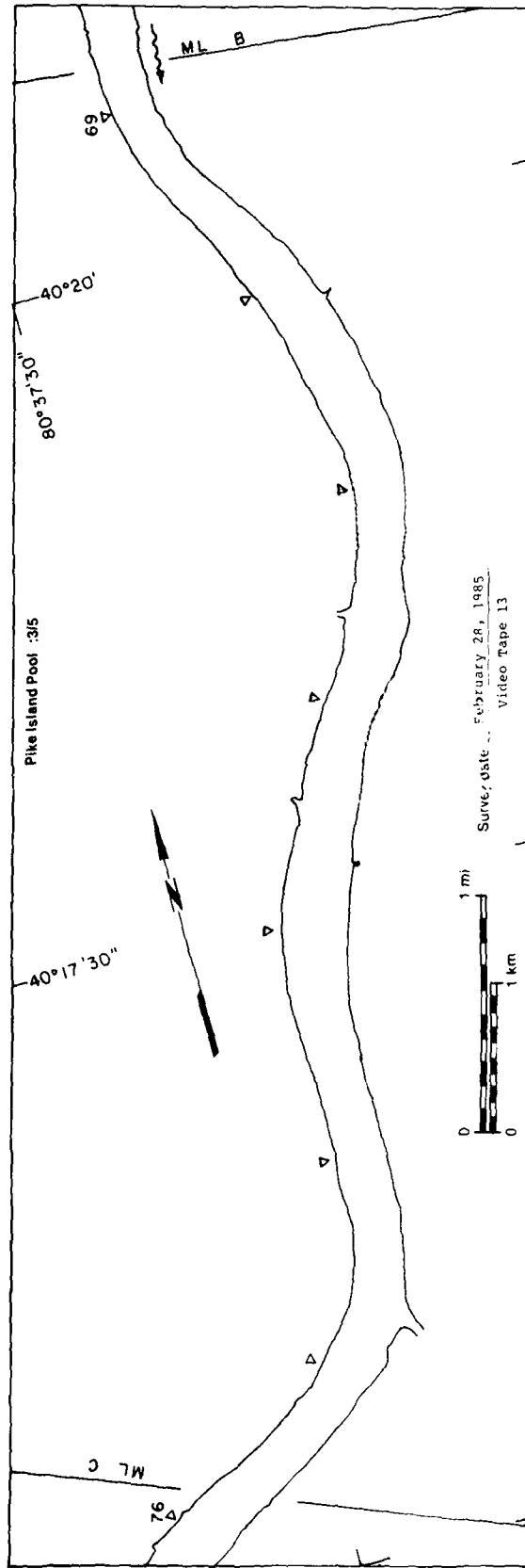
New Cumberland Pool

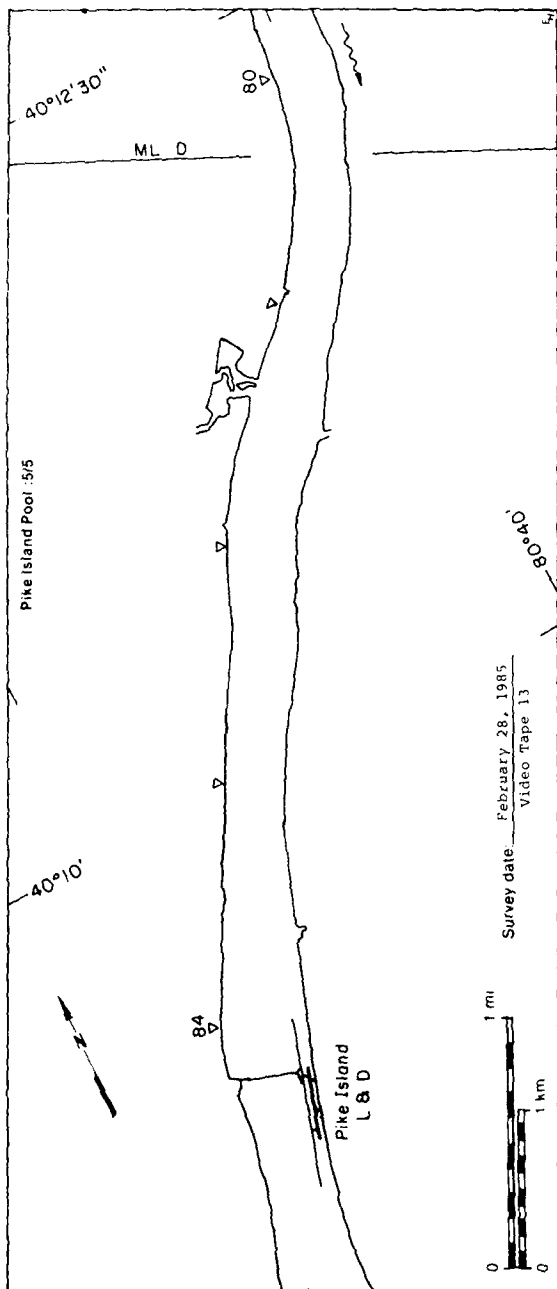
MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	14.87	NA
Solid ice cover	---	NA
Solid ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	---	---
Ice floes or frazil slush and pans	---	---
Total Area (m² x 10⁶)	14.87	





28 February 1985





Pike Island Pool

MAP UNITS

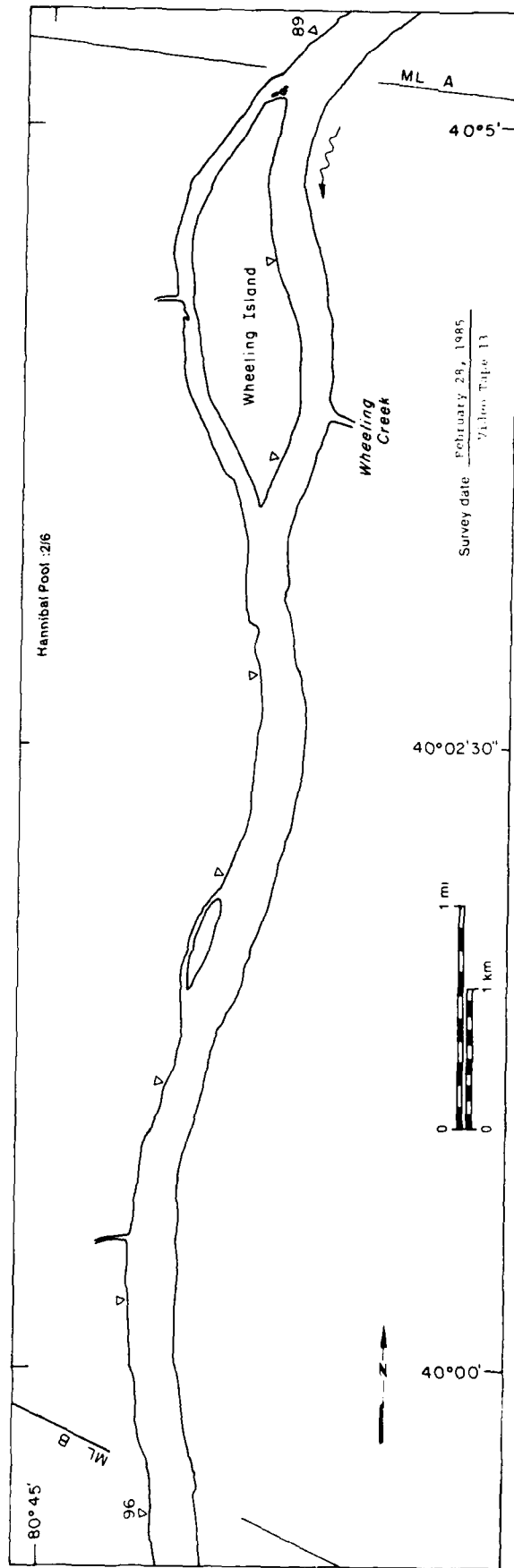
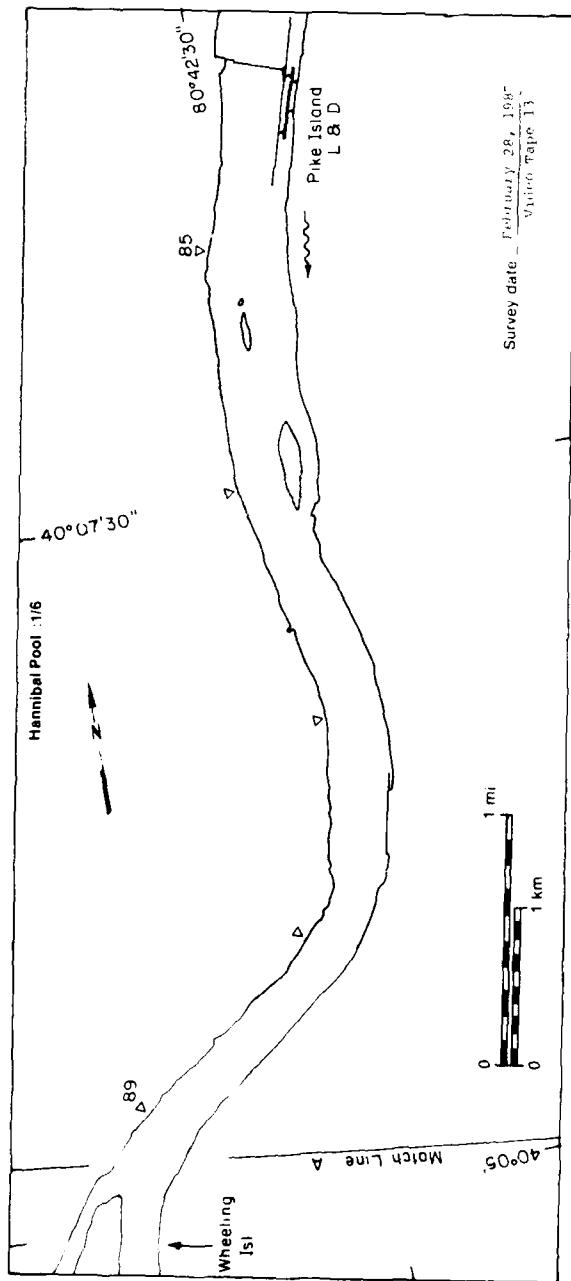
- Open water
- Solid ice cover
- Solid ice cover with open-water areas
- Fragmented ice cover
- Fragmented ice cover with open-water areas
- Ice floes or frazil slush and pans

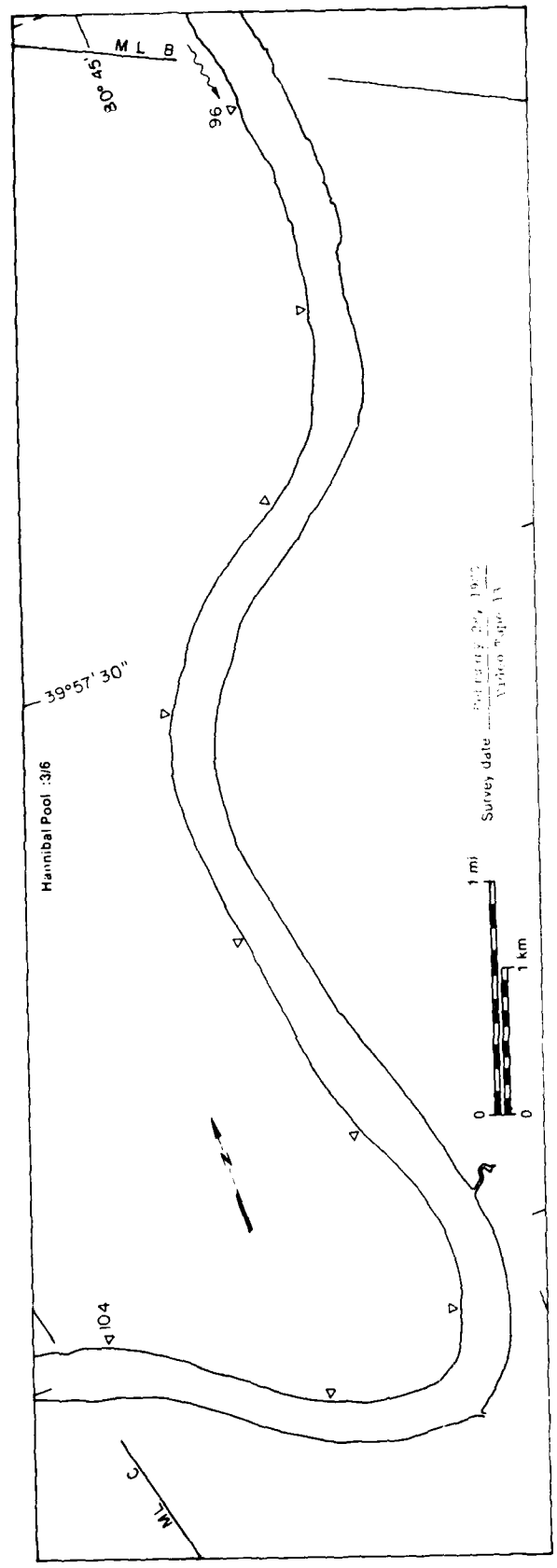
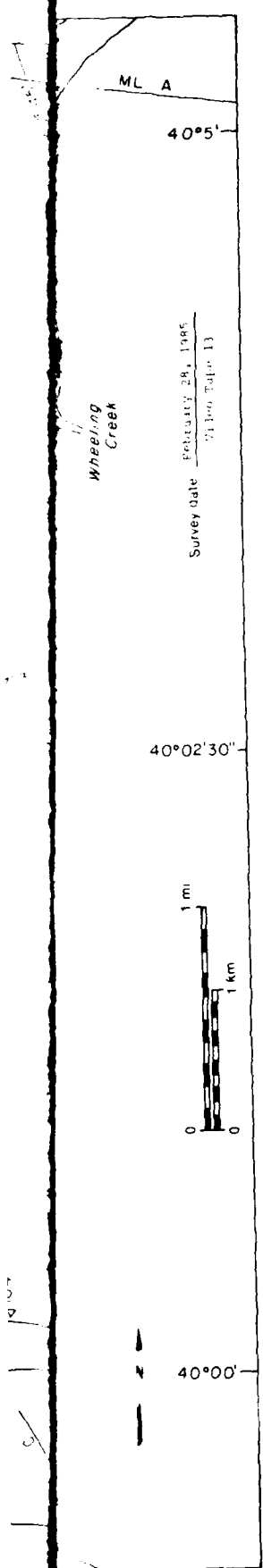
Surface concentration
($m^2 \times 10^6$)

18.02	NA
---	NA
---	---
---	NA
---	---
---	---
18.02	

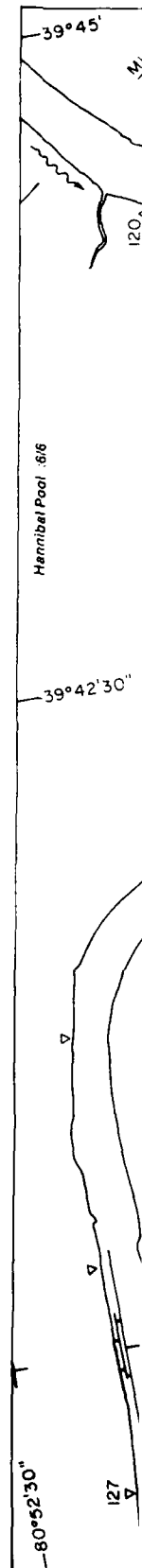
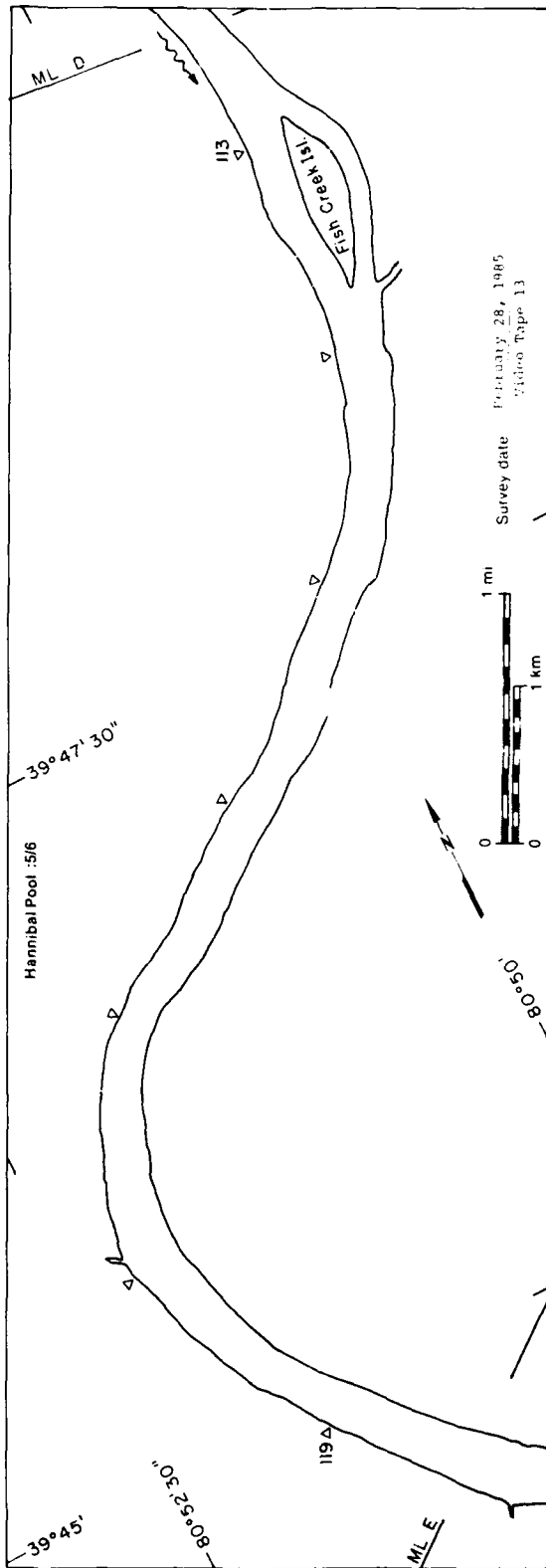
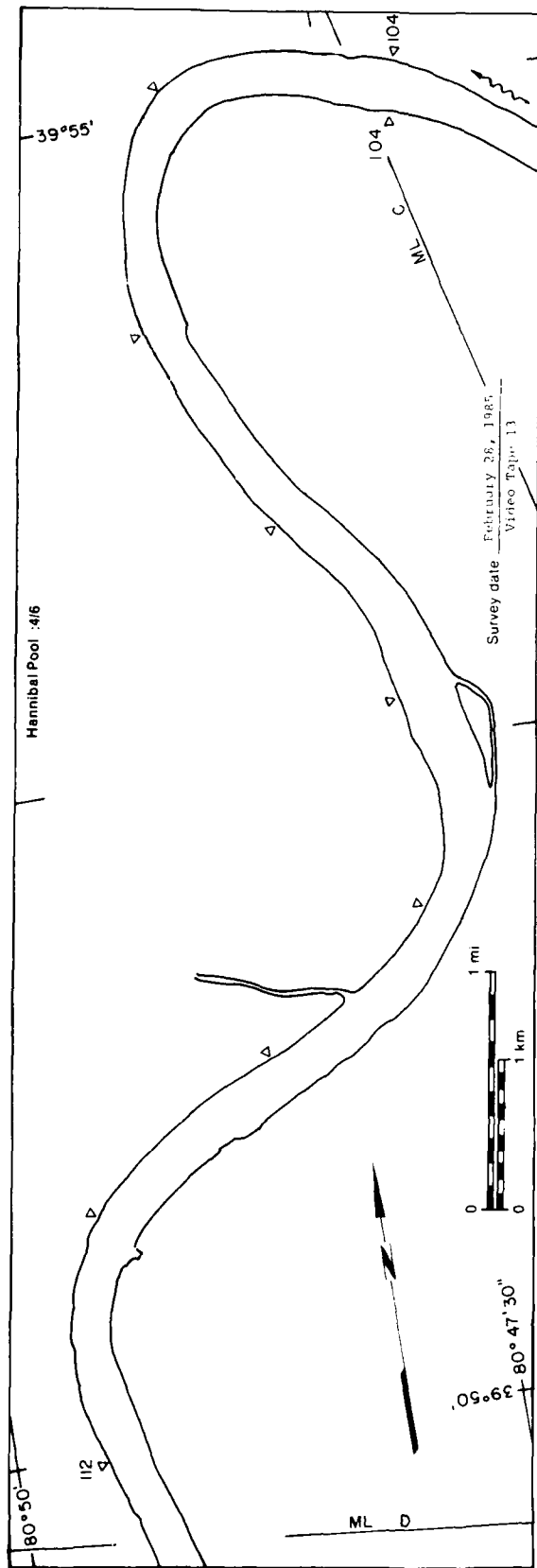
Total Area ($m^2 \times 10^6$)

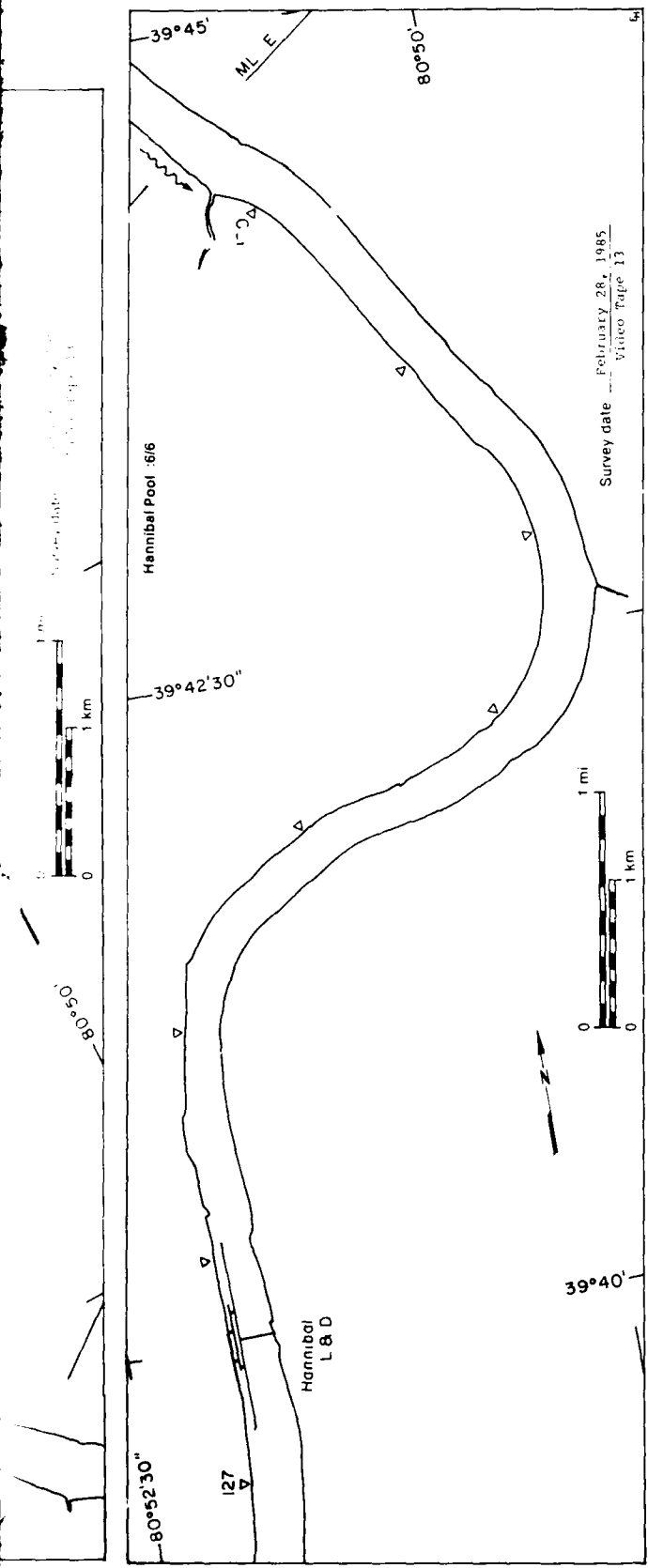
28 February 1985





28 February 1985

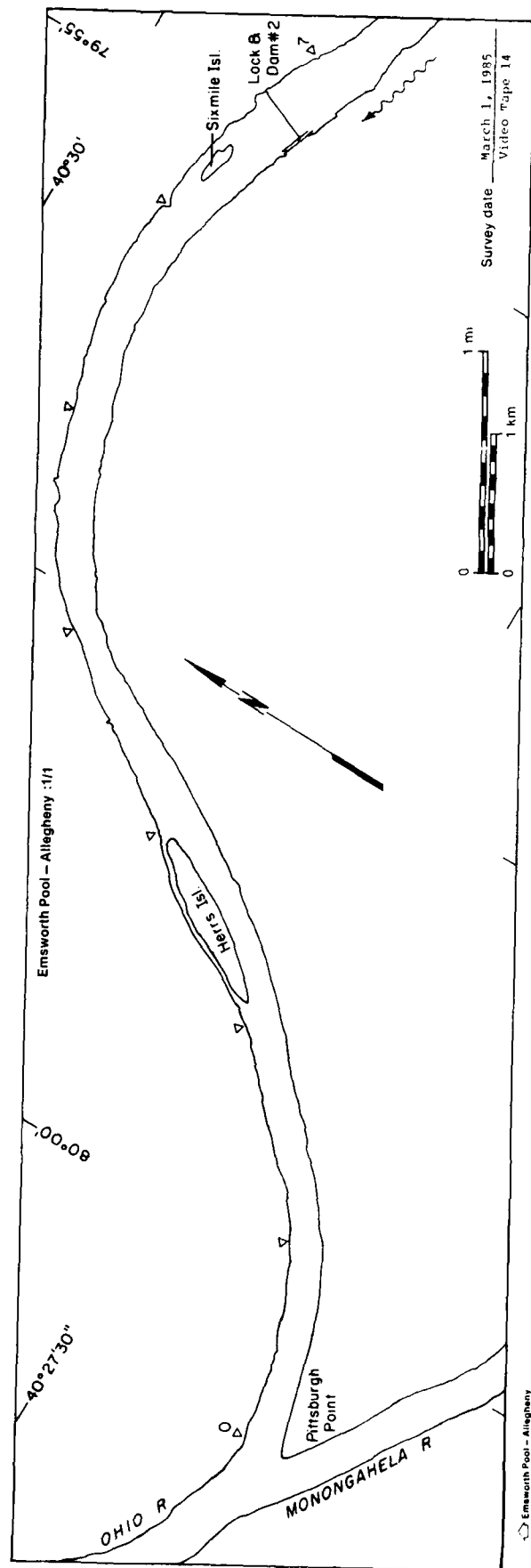




Hannibal Pool

MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	22.46	NA
Solid ice cover	---	NA
Solid ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	---	---
Ice floes or frazil slush and pans	---	---
Total Area (m² x 10⁶)	22.46	

1 March 1985

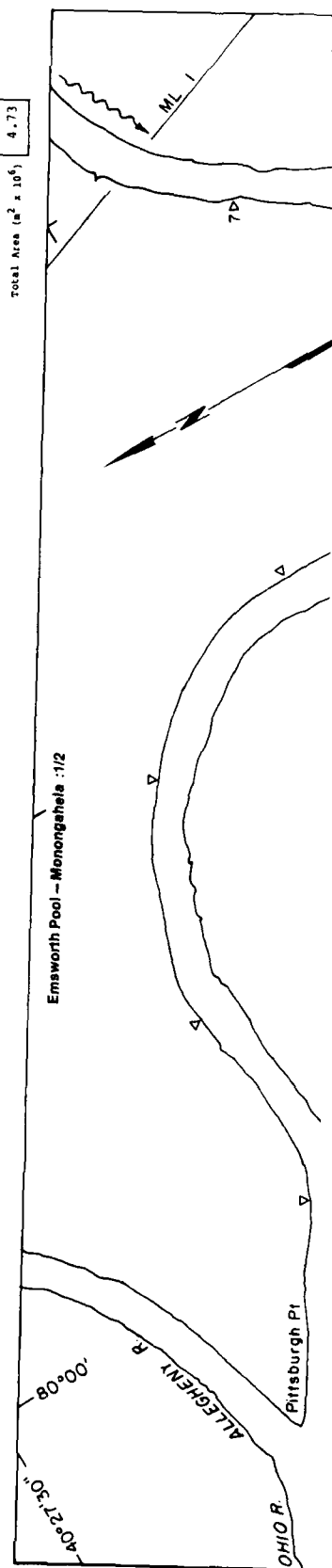


Ensworth Pool - Allegheny

MAP UNIT	Area (a ² x 10 ⁶)	Surface concentration (%)
Open water	3.27	NA
Solid ice cover	---	NA
Solid ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	---	---
Ice floes or fragment and pans	---	---
Total Area (a² x 10⁶)	3.27	

Ensworth Pool - Monongahela

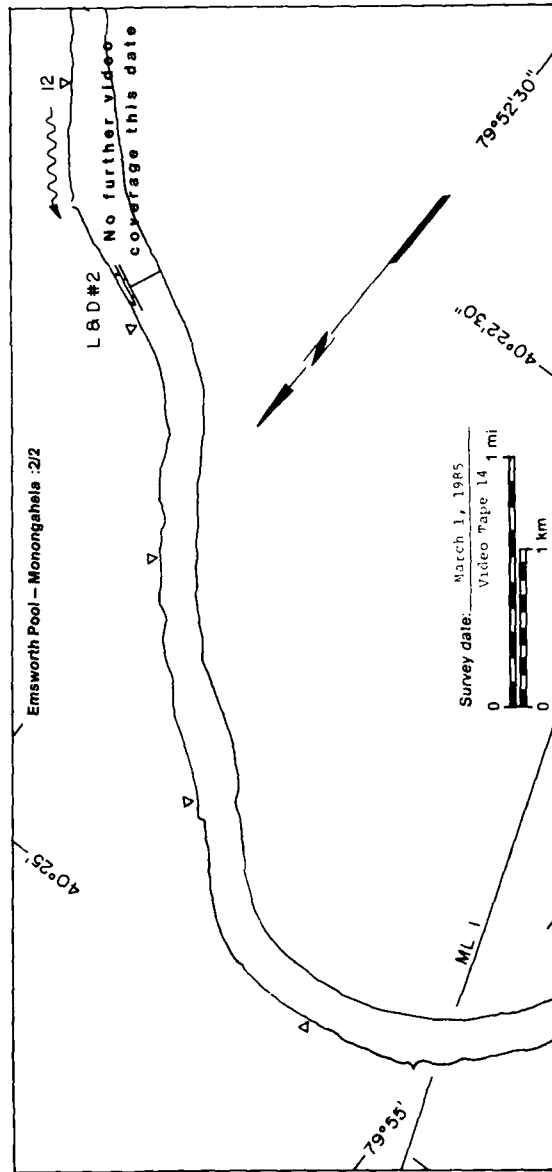
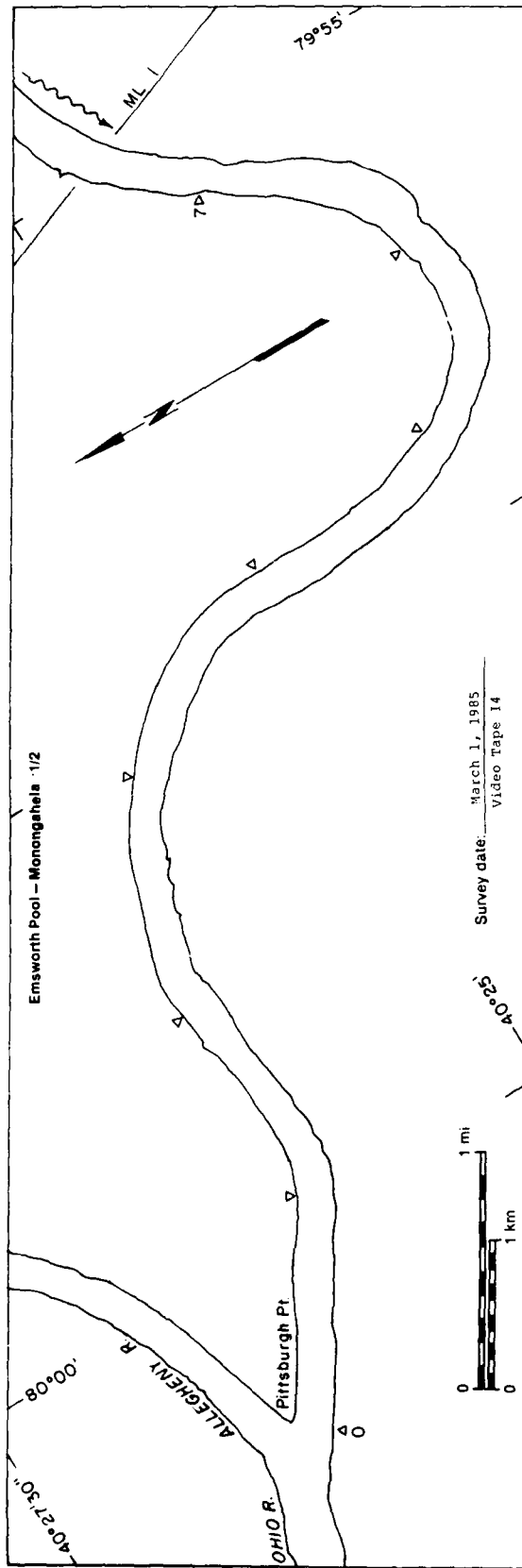
MAP UNIT	Area (a ² x 10 ⁶)	Surface concentration (%)
Open water	4.73	NA
Solid ice cover	---	NA
Solid ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	---	---
Ice floes or fragment and pans	---	---
Total Area (a² x 10⁶)	4.73	



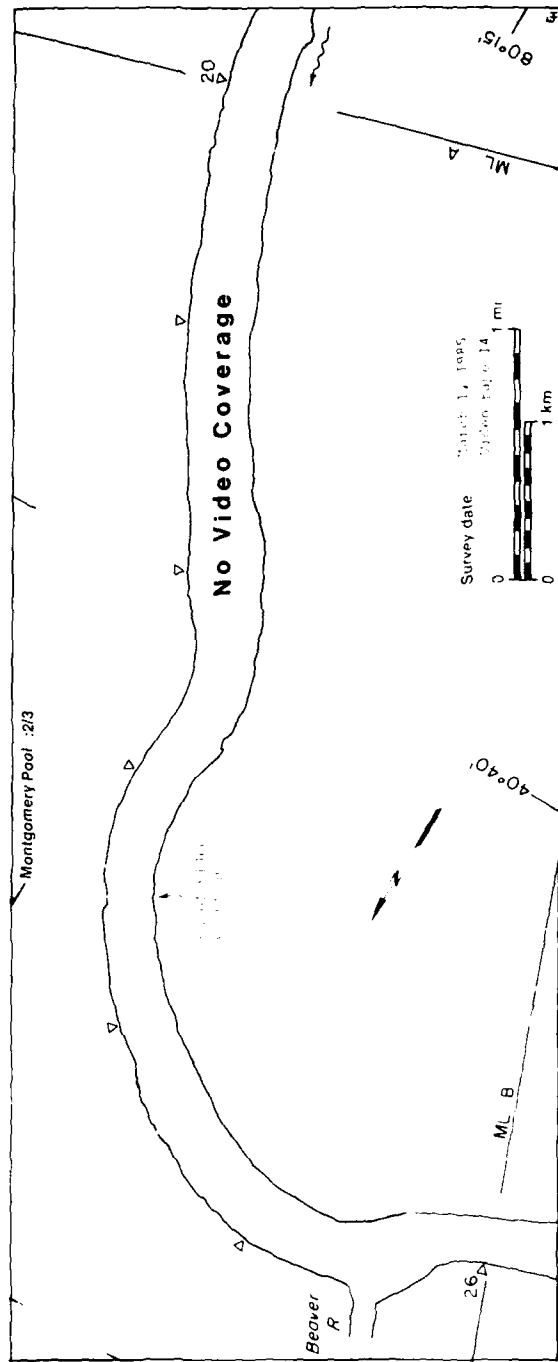
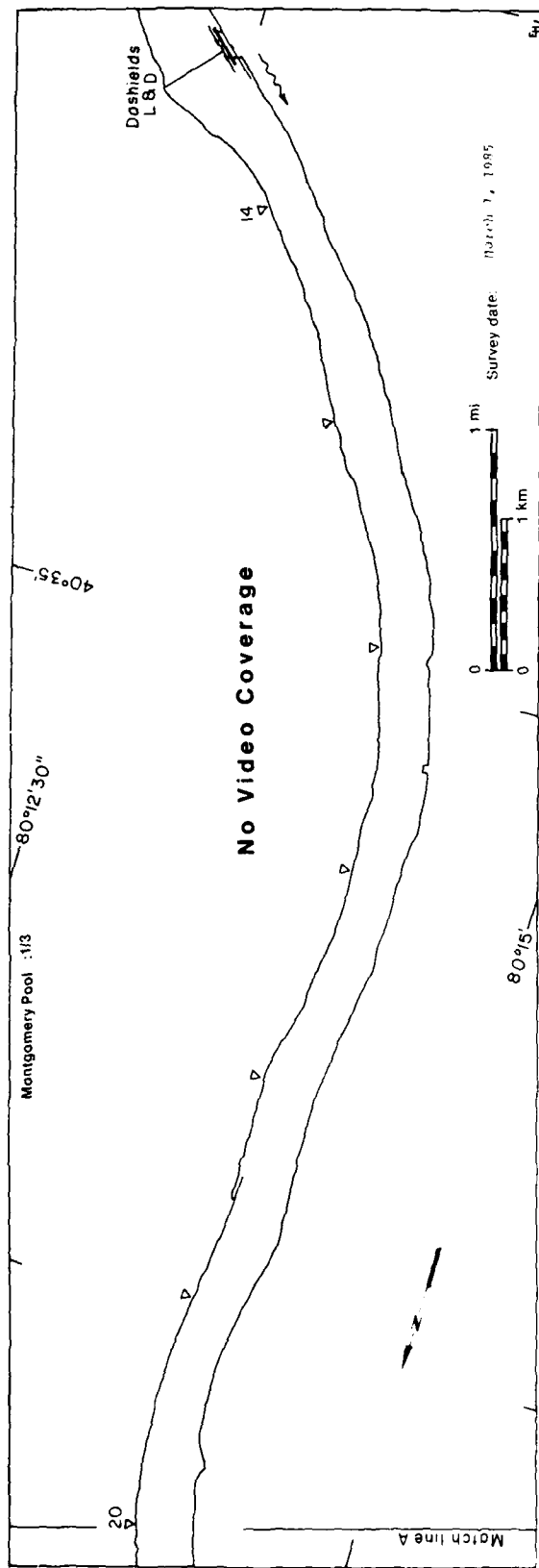
Ensworth Pool - Monongahela :1/2

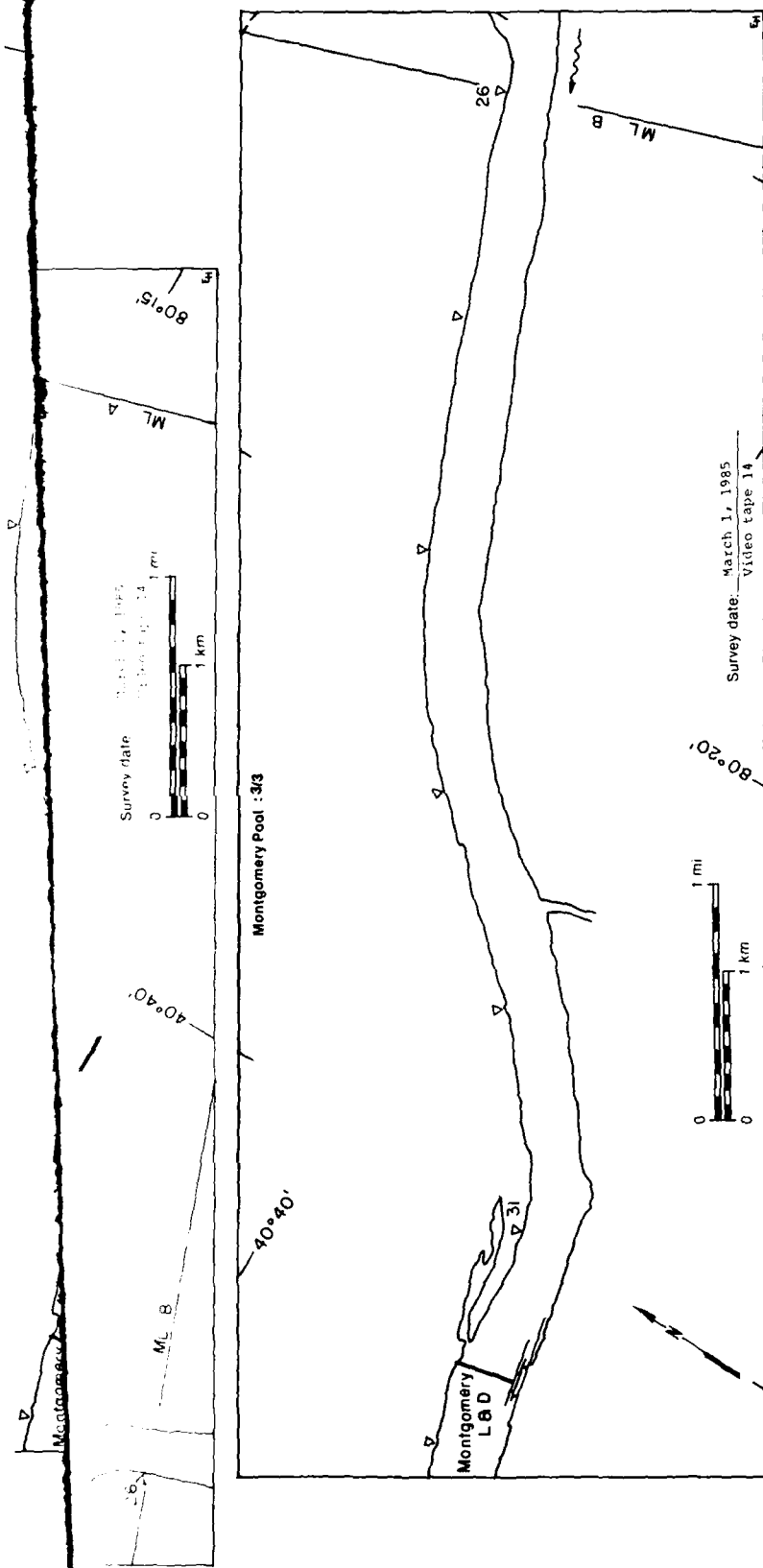
4.73

Total Area ($\text{mi}^2 \times 10^6$)



1 March 1985



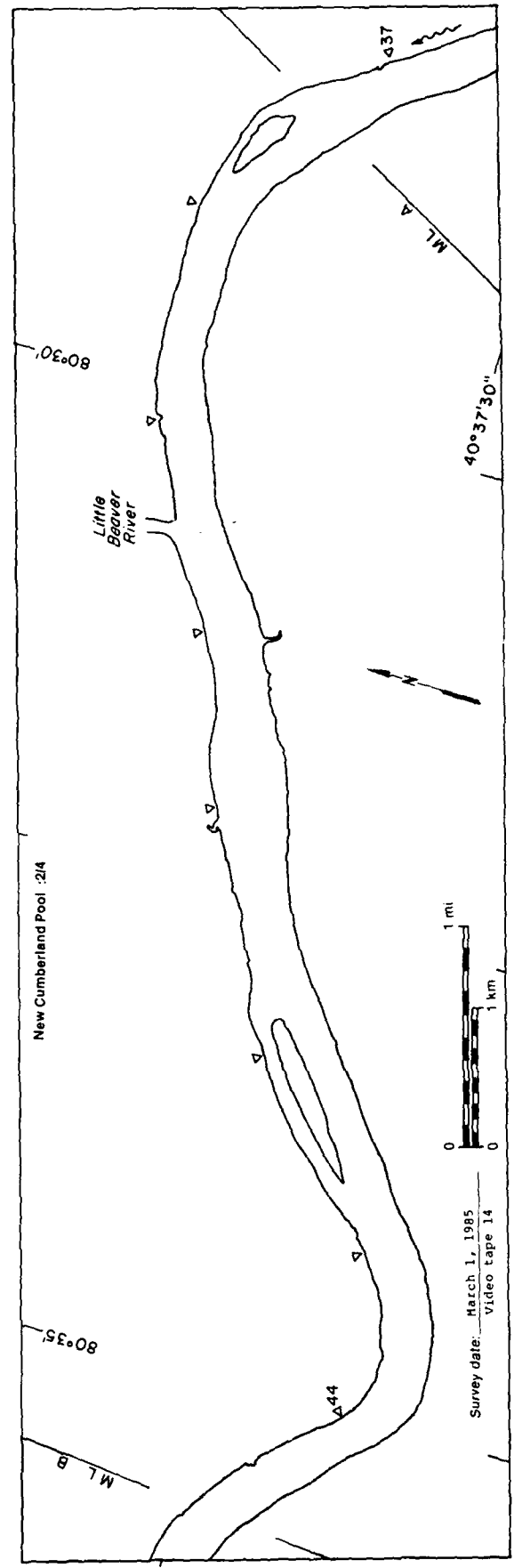
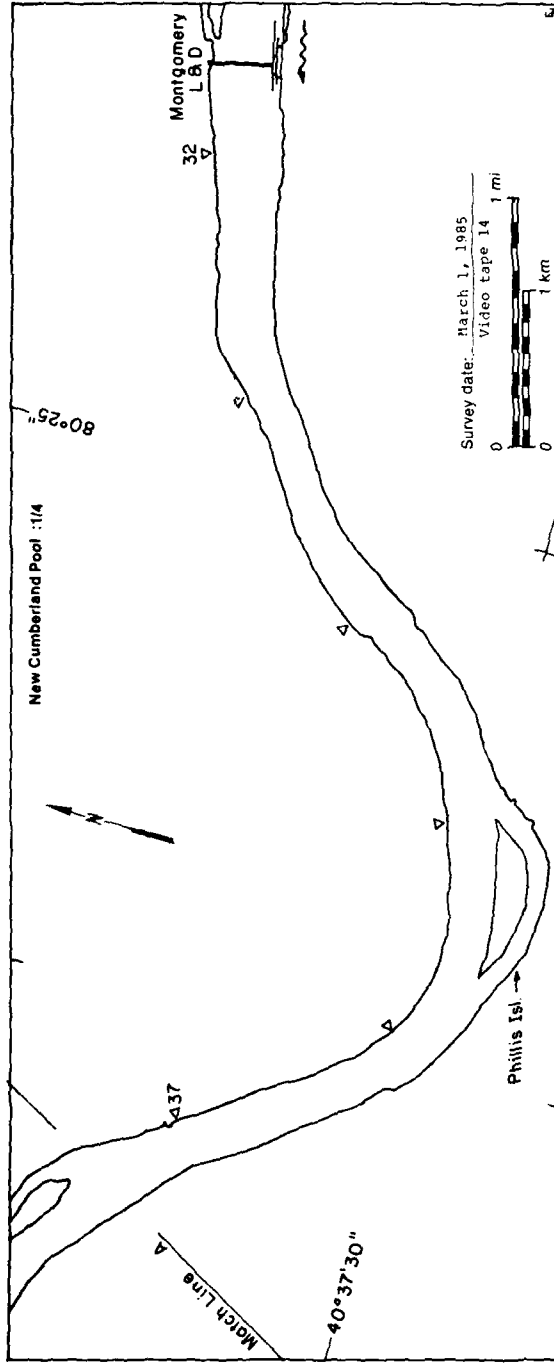


Montgomery Pool

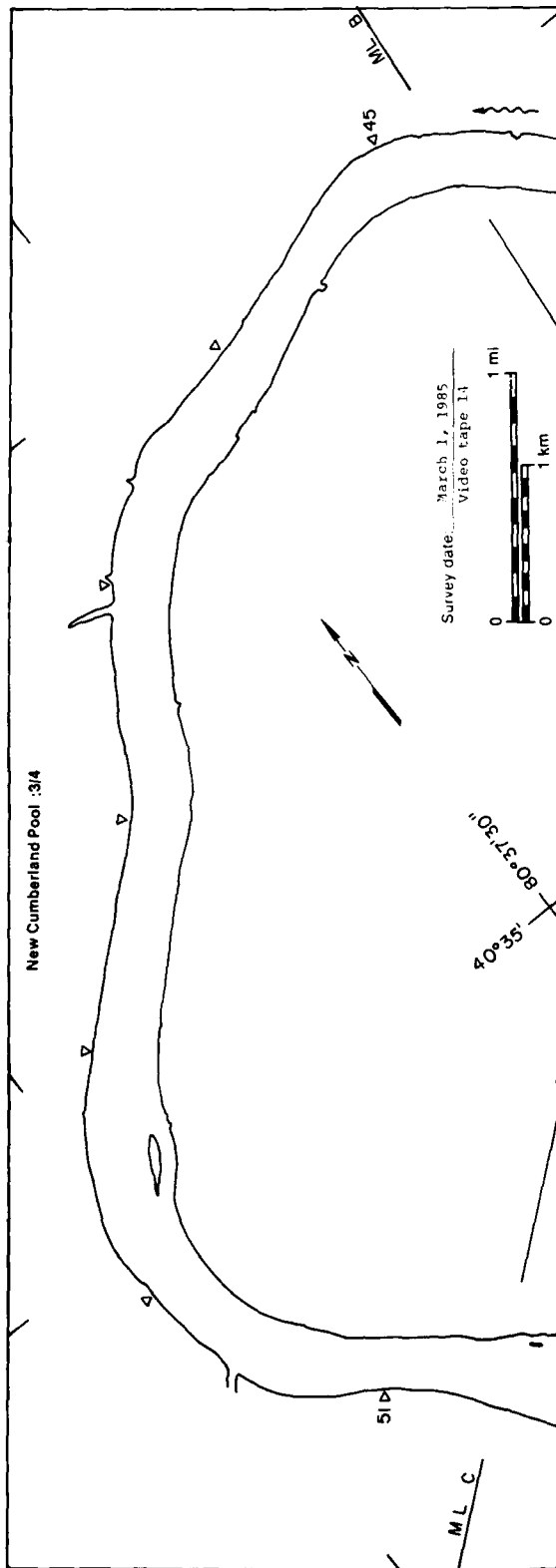
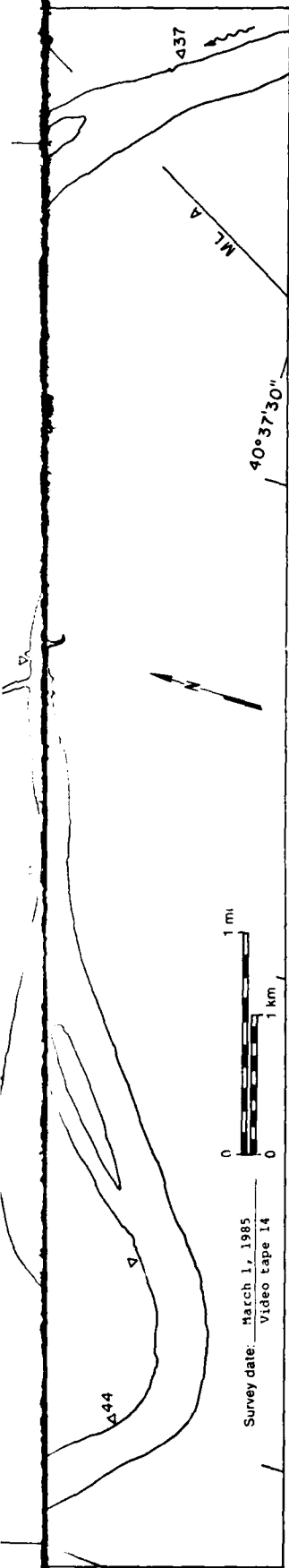
MAP UNITS	Area ₁ (m ² x 10 ⁶)	Surface concentration (%)
Open water	5.03	NA
Solid ice cover	---	NA
Solid ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	---	---
Ice floes or frazil slush and pans	---	---
Total Area (m² x 10⁶)	11.27*	

*Includes 6.24 no video coverage

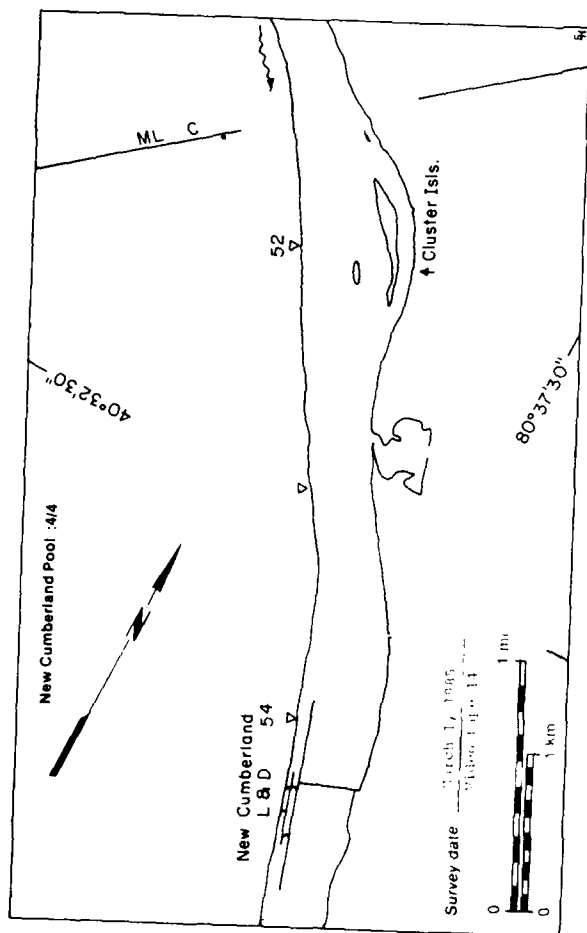
1 March 1985



New Cumberland Pool :3/4

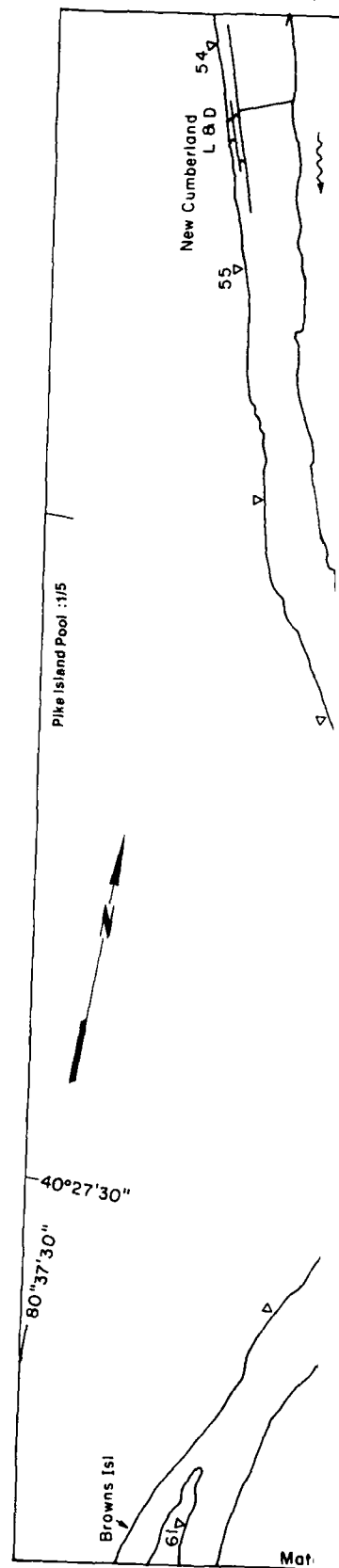


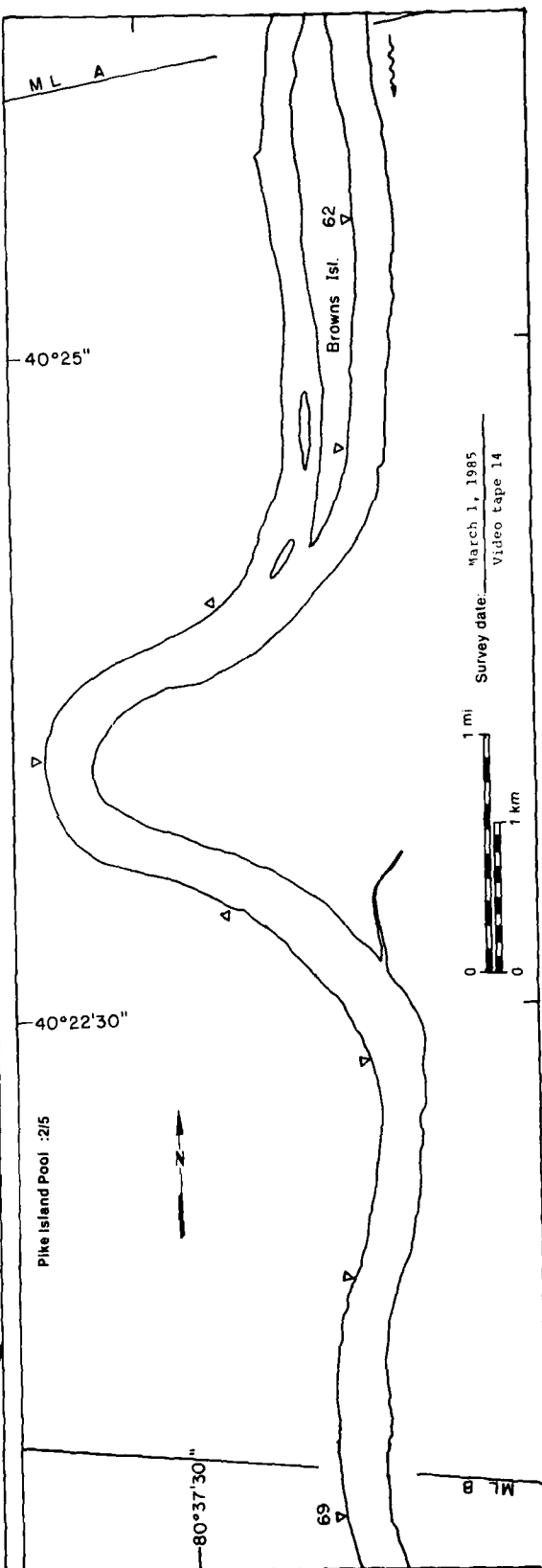
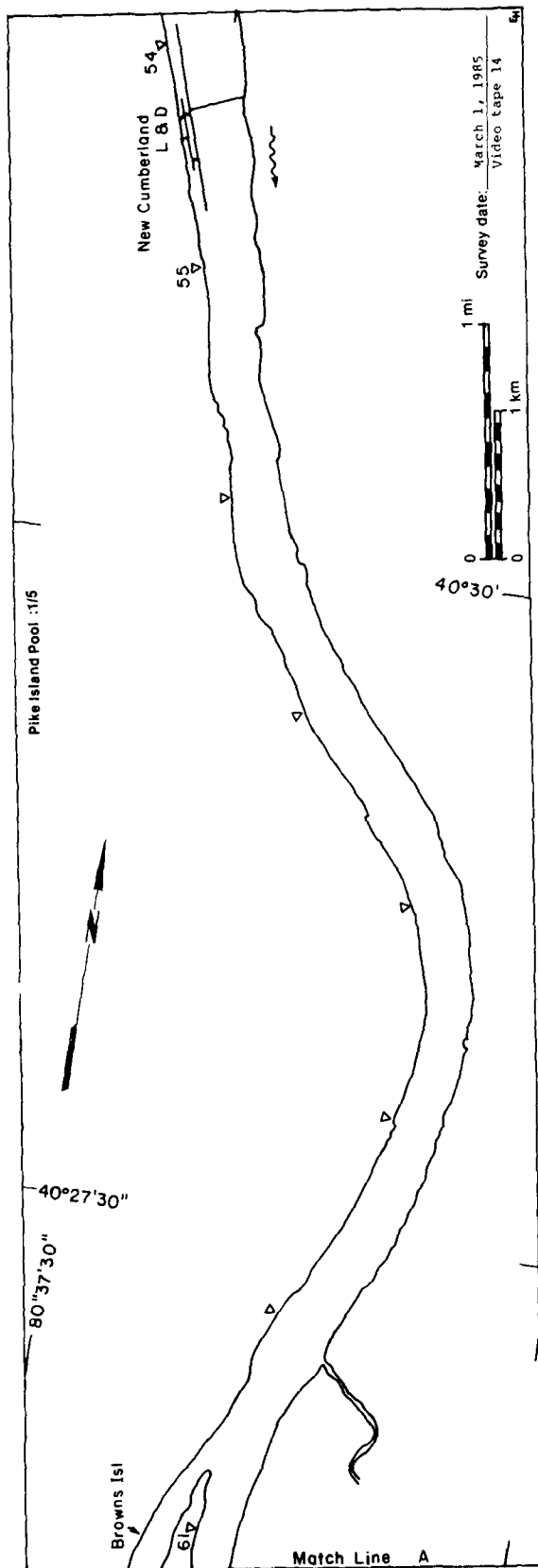
1 March 1985



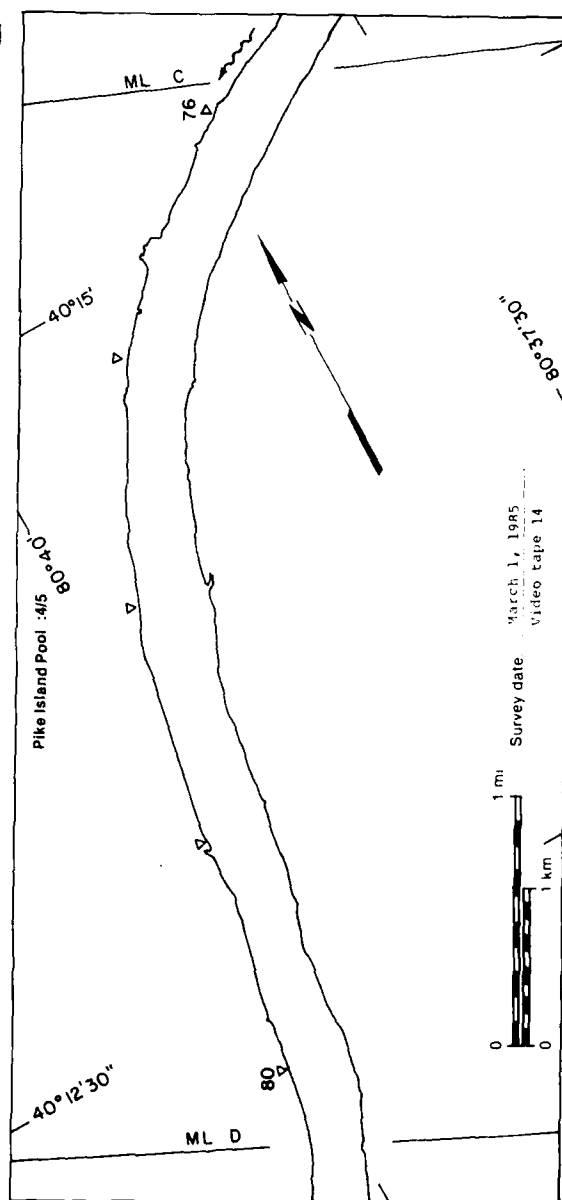
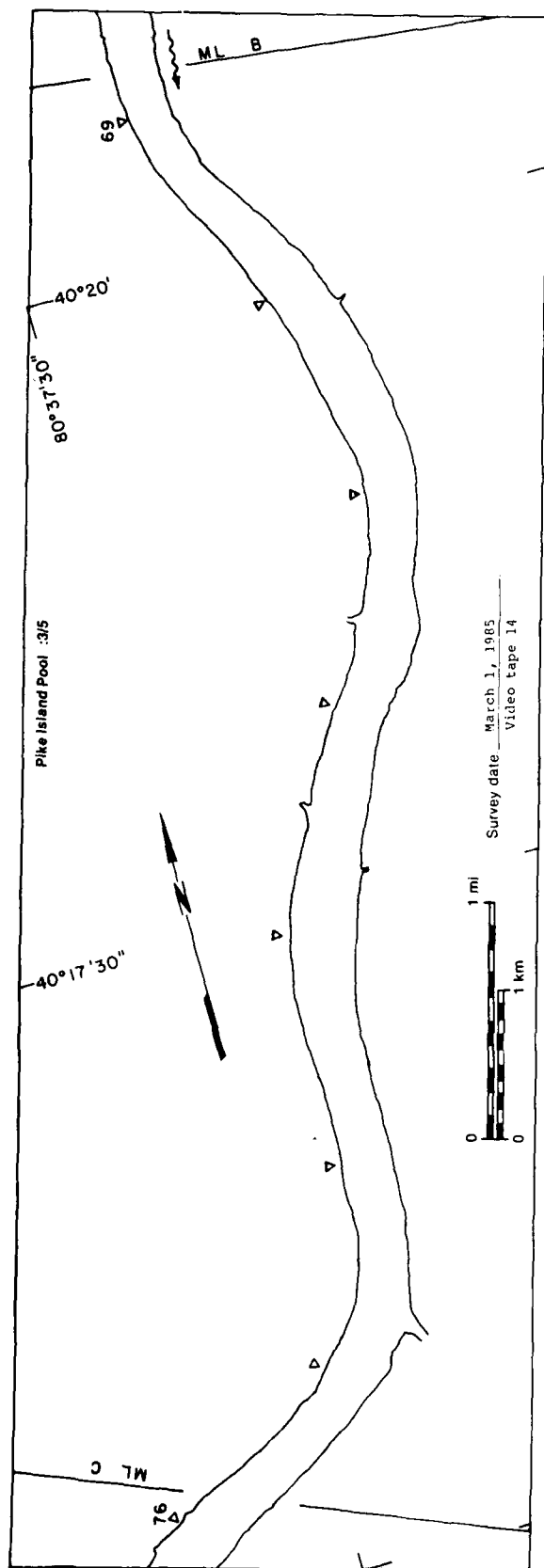
New Cumberland Pool

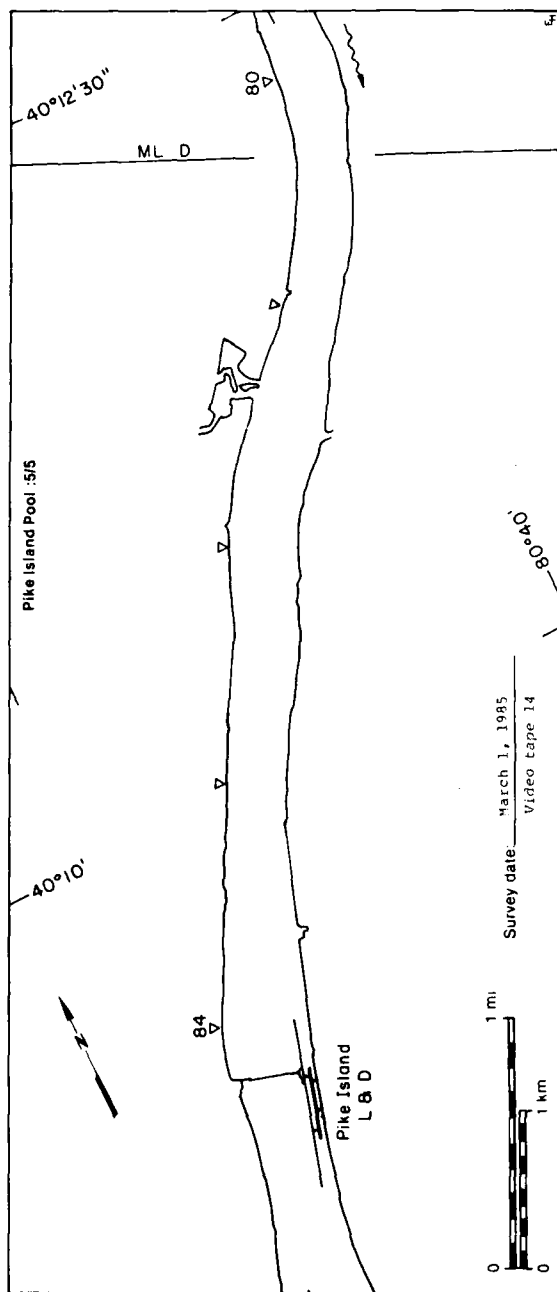
MAP UNITS	Area, 10^6 m^2	Surface concentration (%)
Open water	14.87	NA
Solid ice cover	---	NA
Solid ice cover with open-water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open-water areas	---	---
Ice floes or frazil slush and pans	---	---
Total Area ($10^6 m^2$)	14.87	





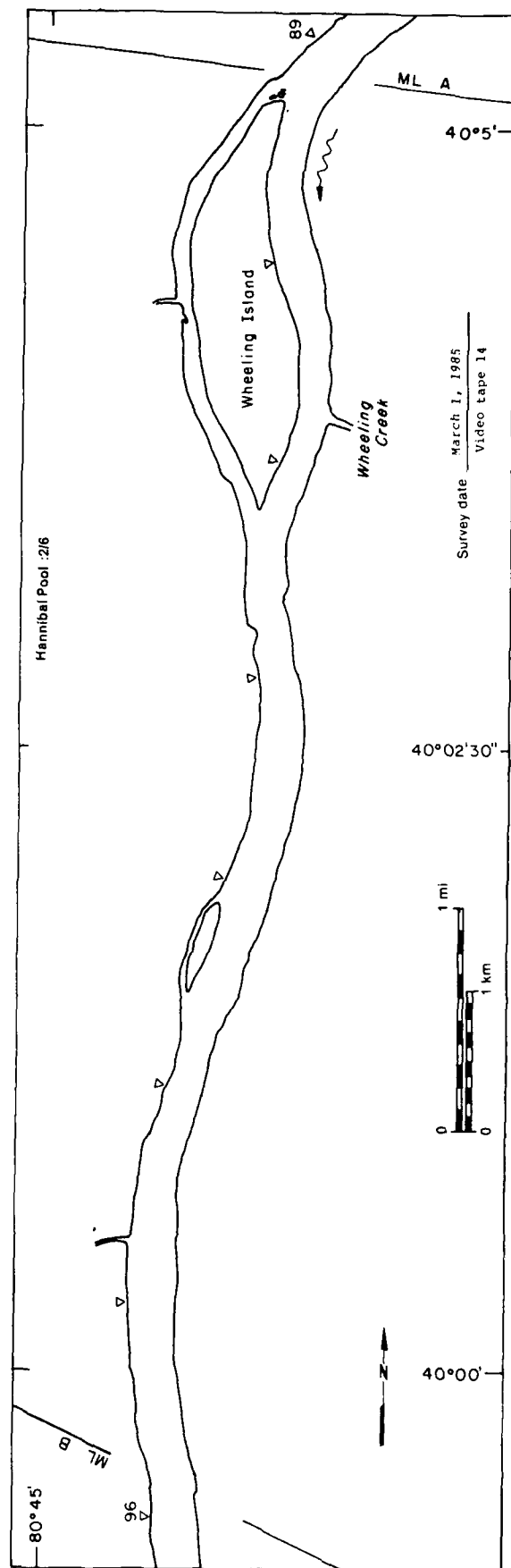
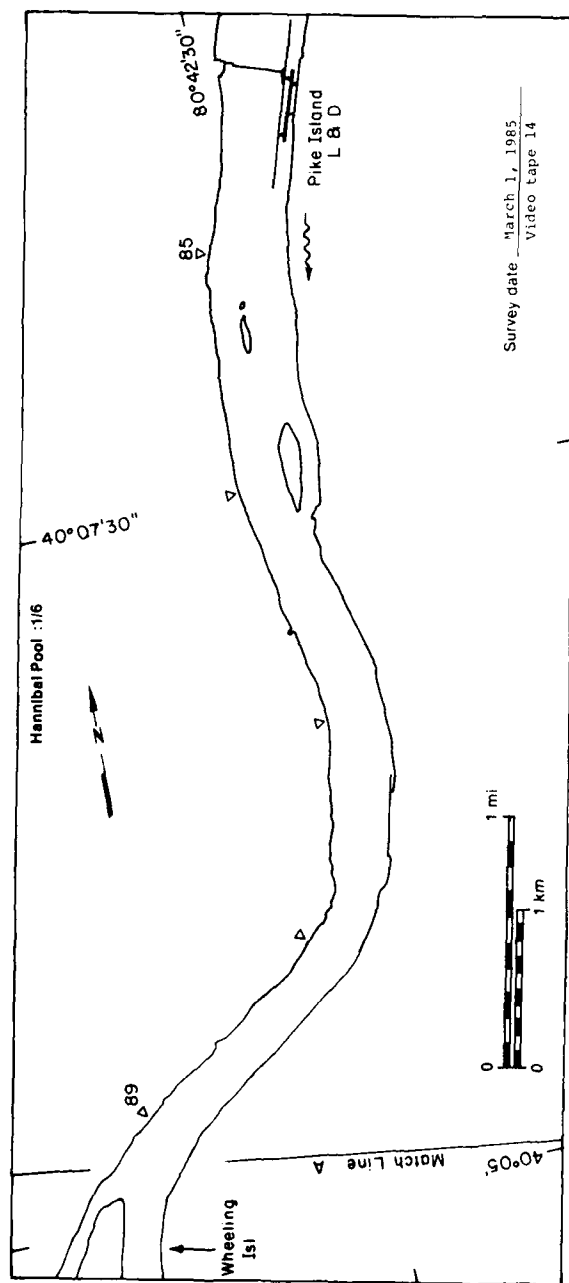
1 March 1985

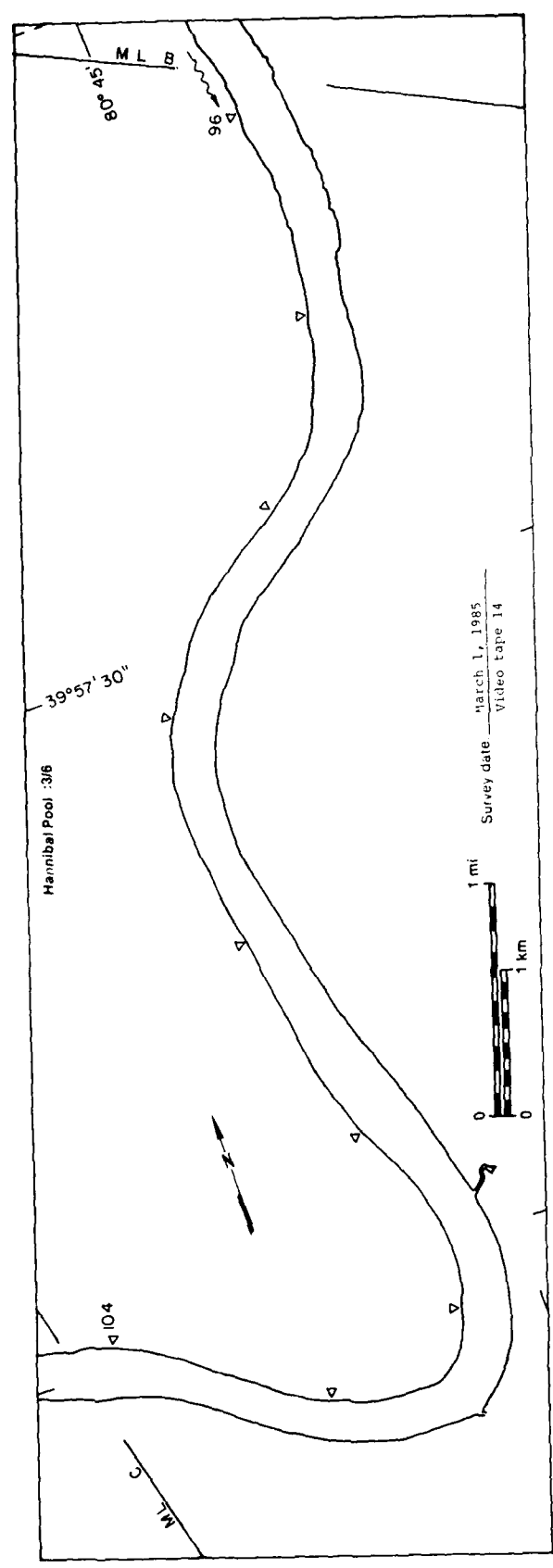
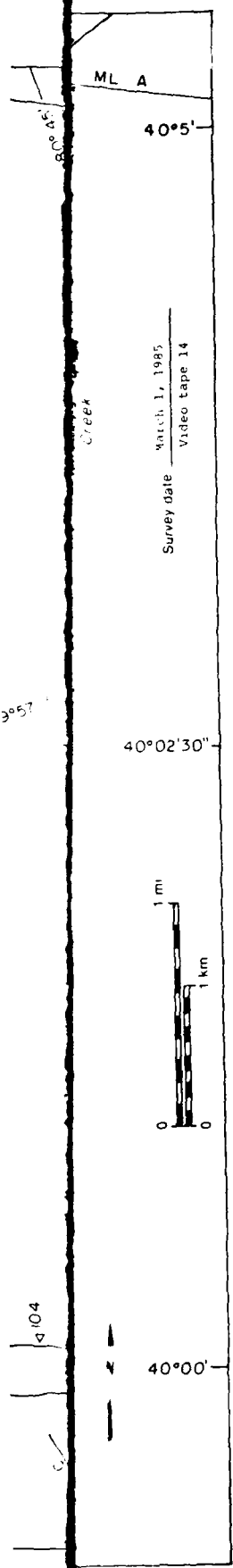




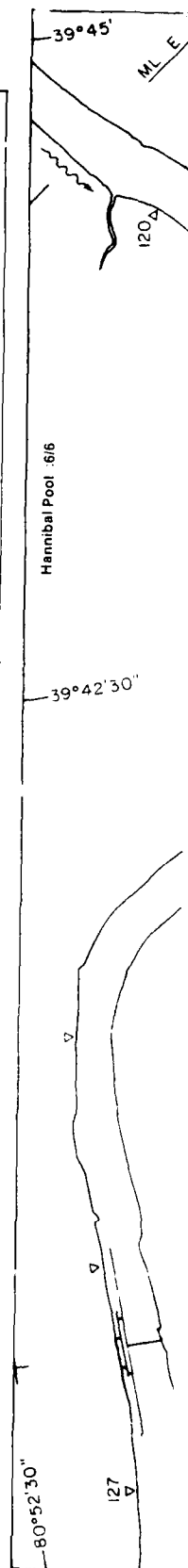
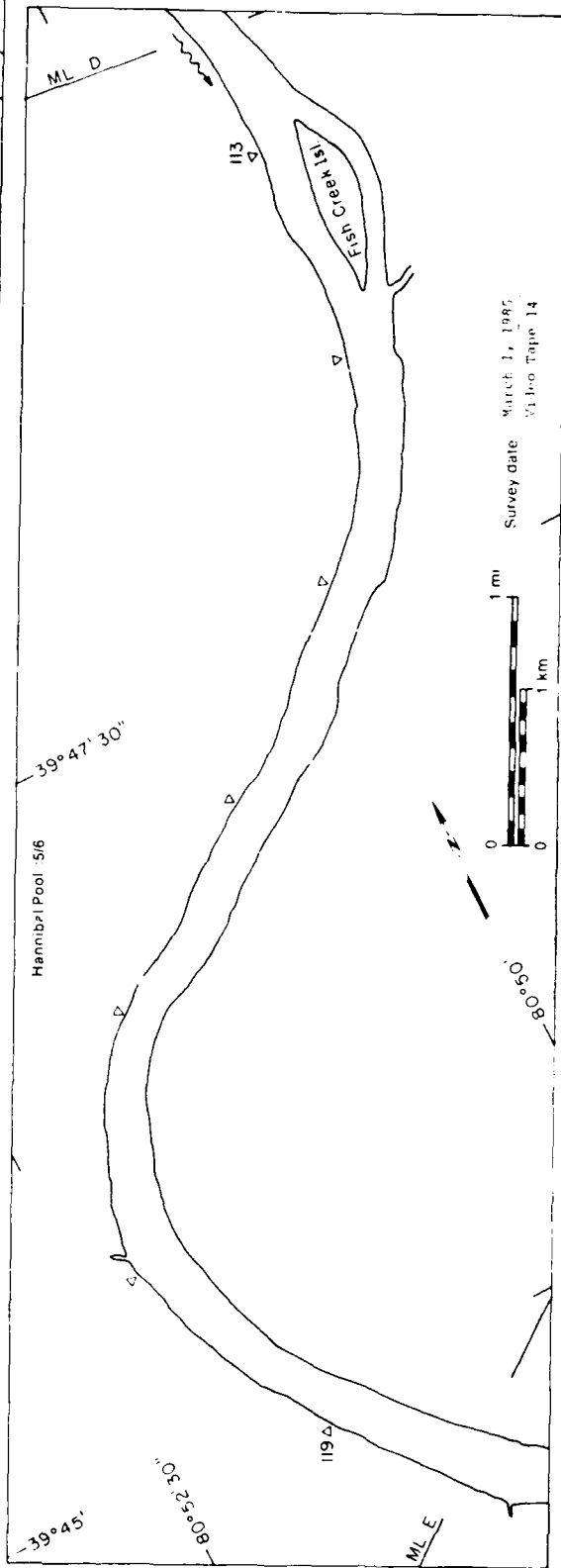
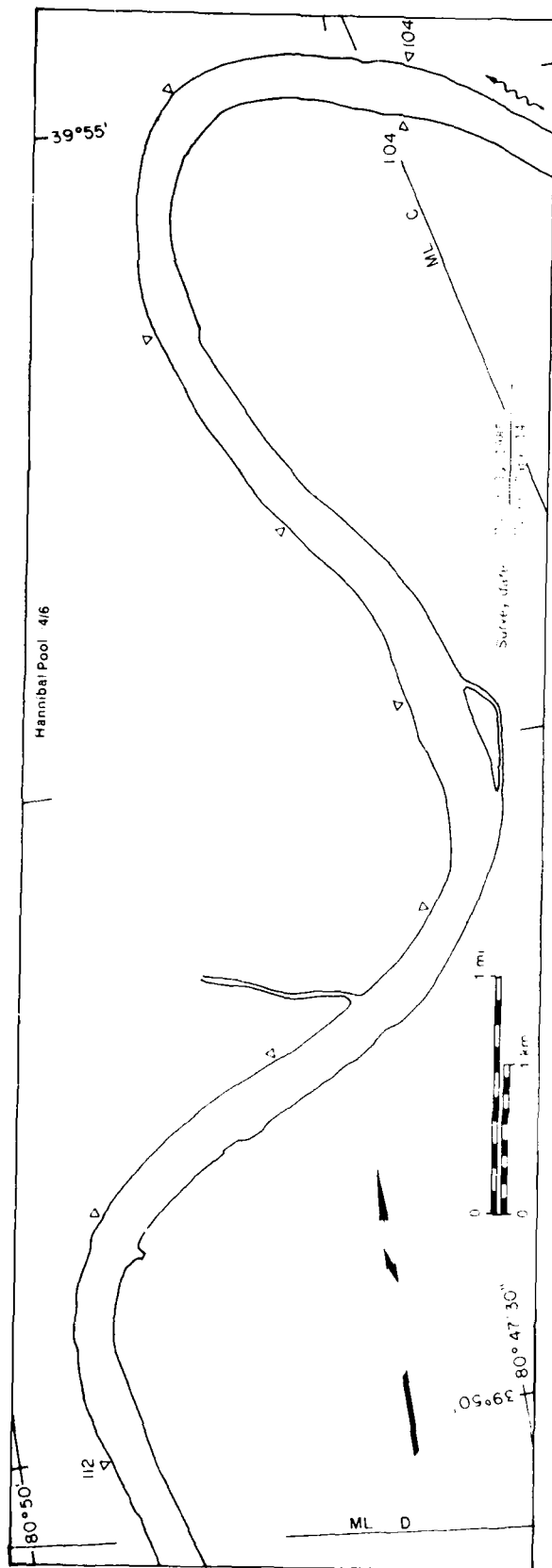
Pike Island Pool		Area 6	Surface
MAP UNITS		(m ² x 10 ⁶)	concentration (%)
Open water		18.92	NA
Solid ice cover		---	NA
Solid ice cover with open-water areas		---	---
Fragmented ice cover		---	NA
Fragmented ice cover with open-water areas		---	---
Ice floes or frazil slush and pans		---	---
Total Area (m ² x 10 ⁶)		18.92	

1 March 1985

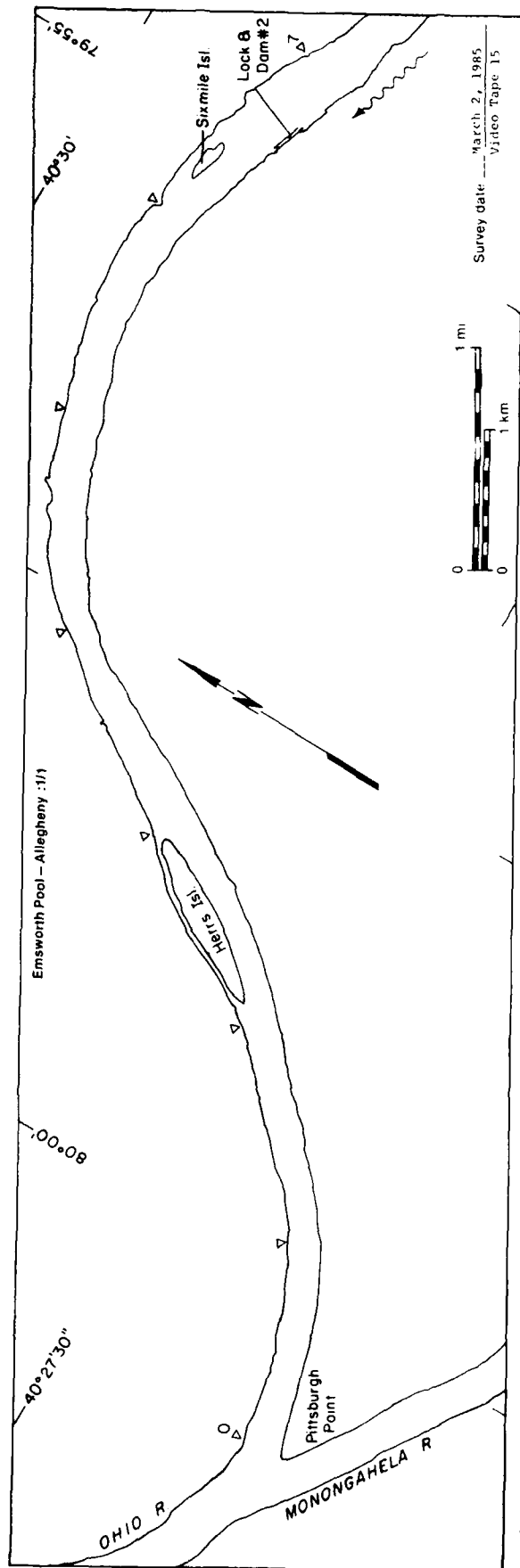




1 March 1985



2 March 1985

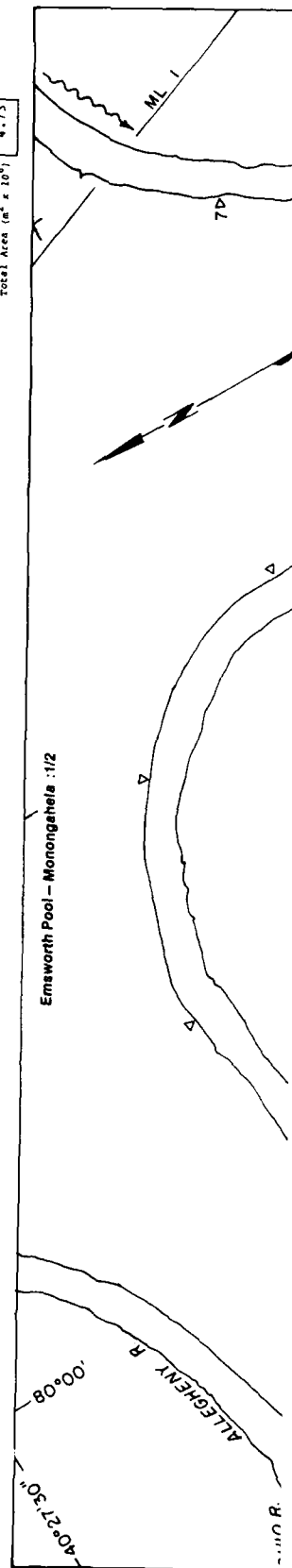


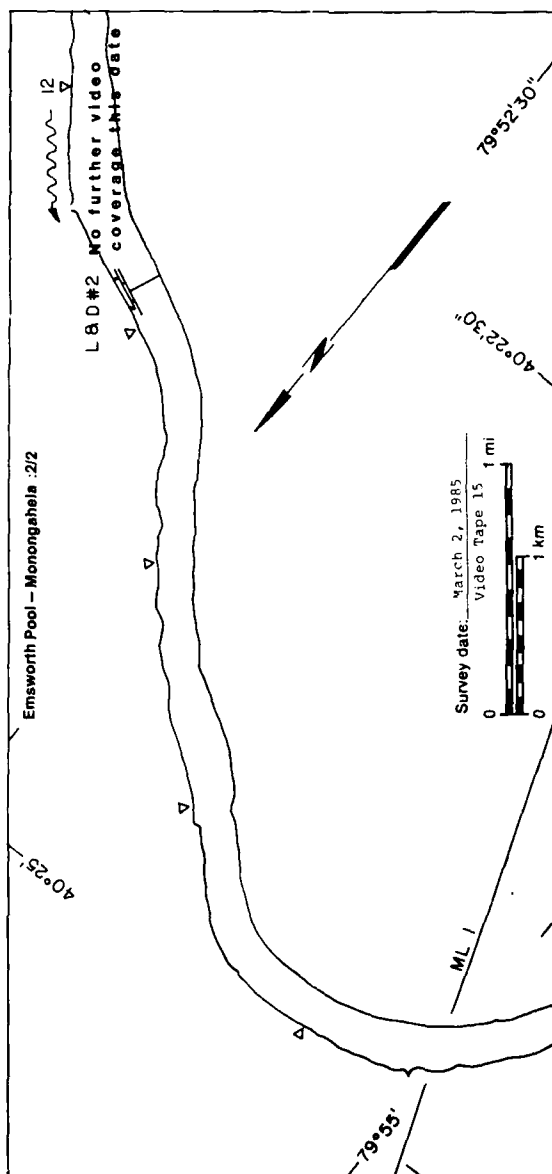
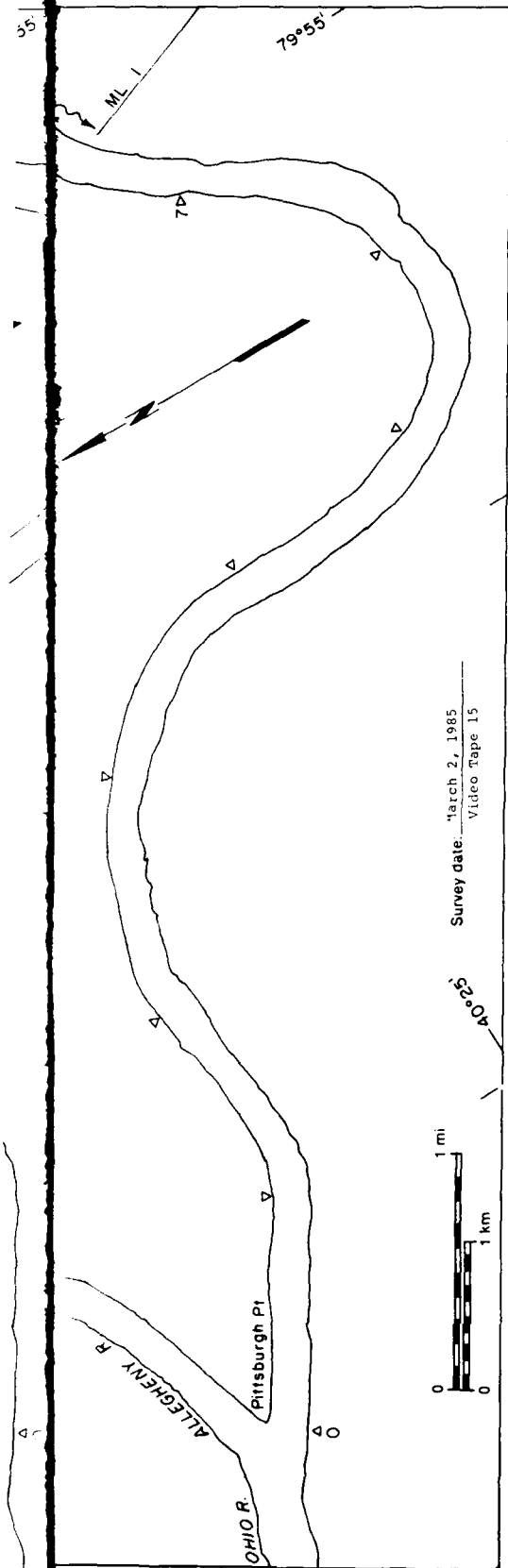
Emsworth Pool - Allegheny

Map Unit	Area (m ² x 10 ⁶)	Surface Concentration (%)
Open water	3.27	NA
Sand bar	---	NA
Sand bar with open water areas	---	---
Fragmented ice cover	---	---
Fragmented ice cover with open water areas	---	---
Fragmented ice cover with open water areas and slush	---	---
Total Area (m ² x 10 ⁶)	3.27	

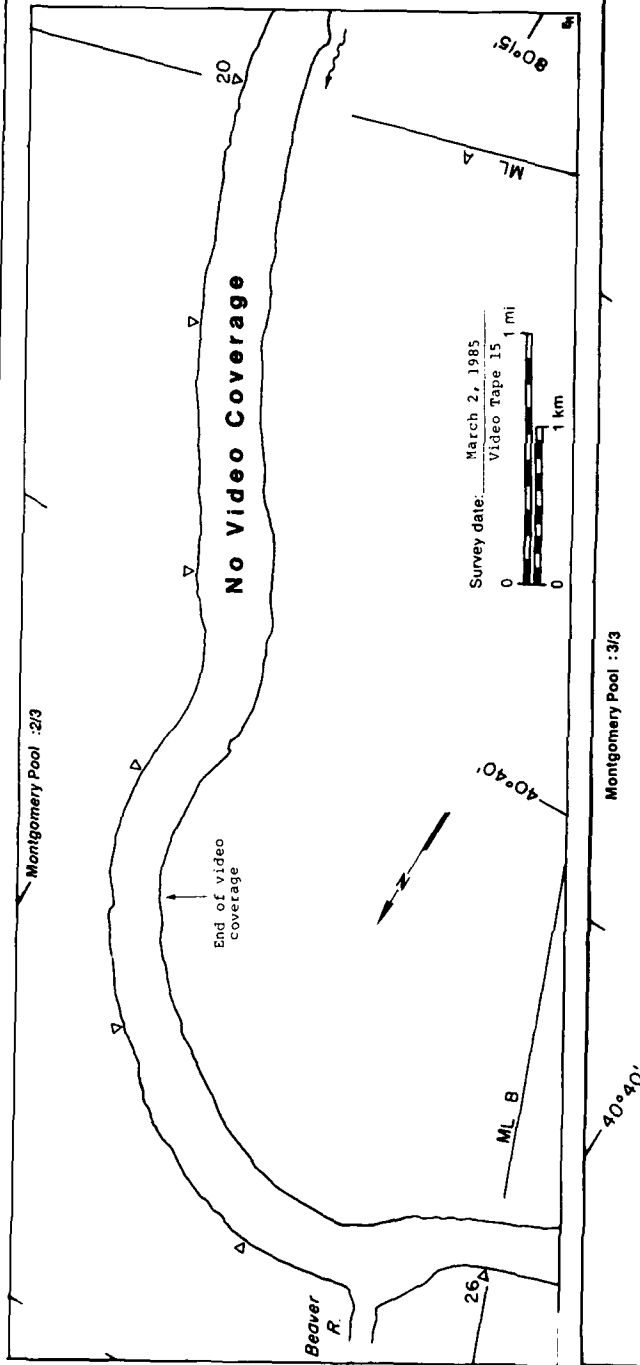
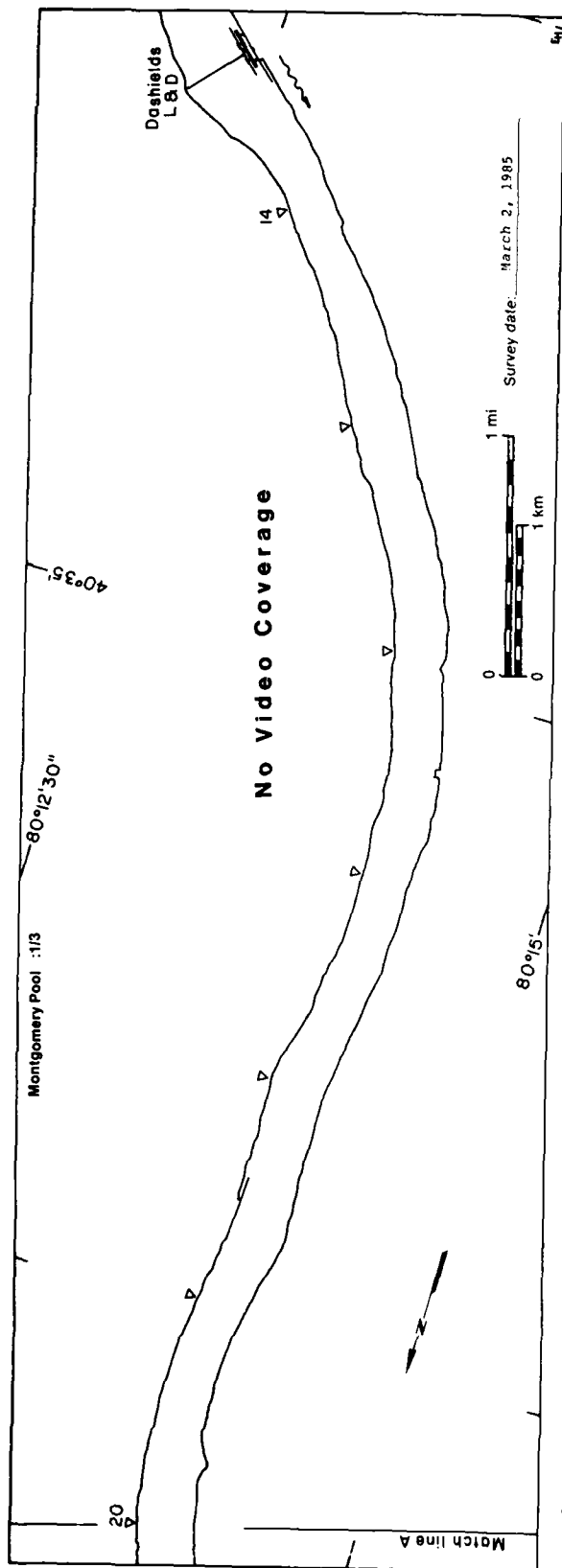
Emsworth Pool - Monongahela

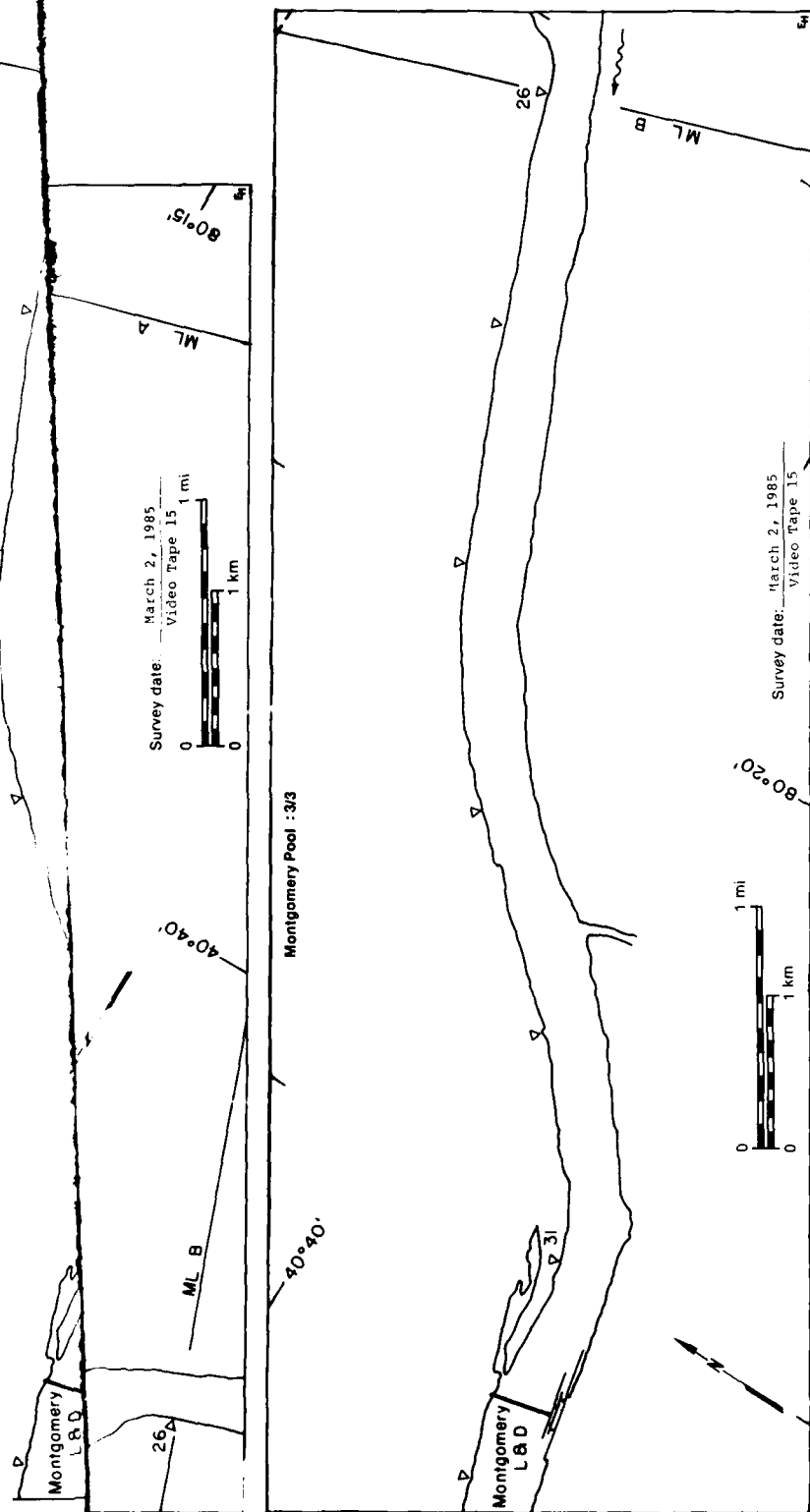
Map Unit	Area (m ² x 10 ⁶)	Surface Concentration (%)
Open water	4.73	NA
Sand bar	---	NA
Sand bar with open water areas	---	---
Fragmented ice cover	---	---
Fragmented ice cover with open water areas	---	---
Fragmented ice cover with open water areas and slush	---	---
Total Area (m ² x 10 ⁶)	4.73	





2 March 1985



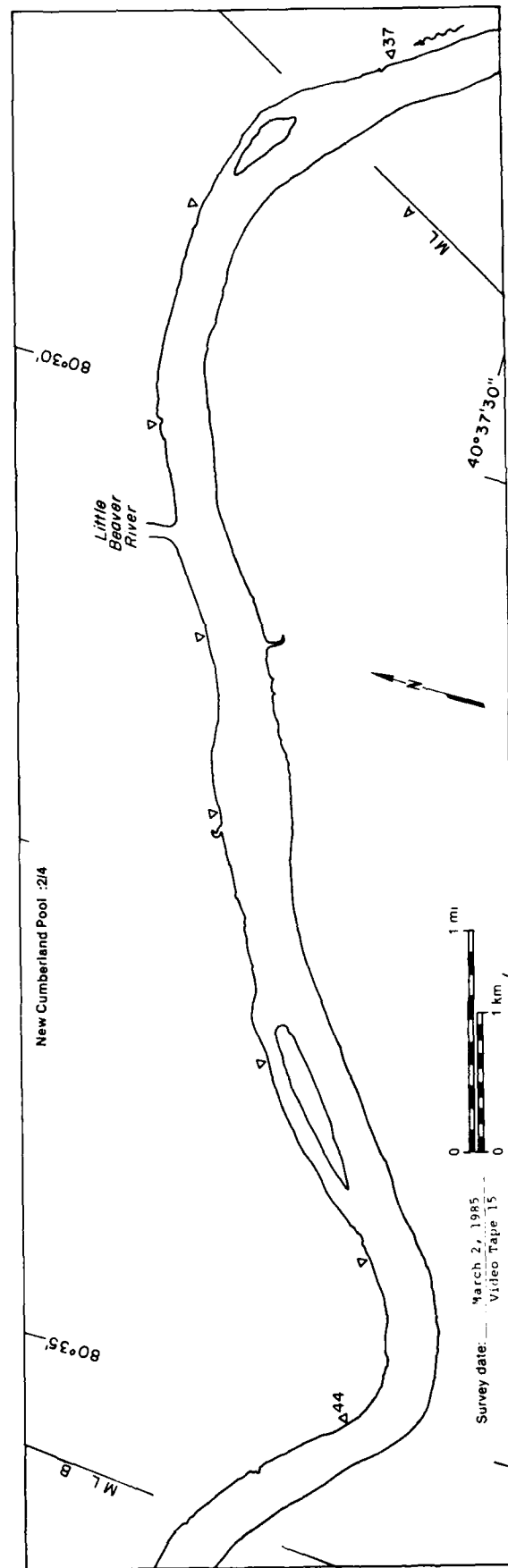
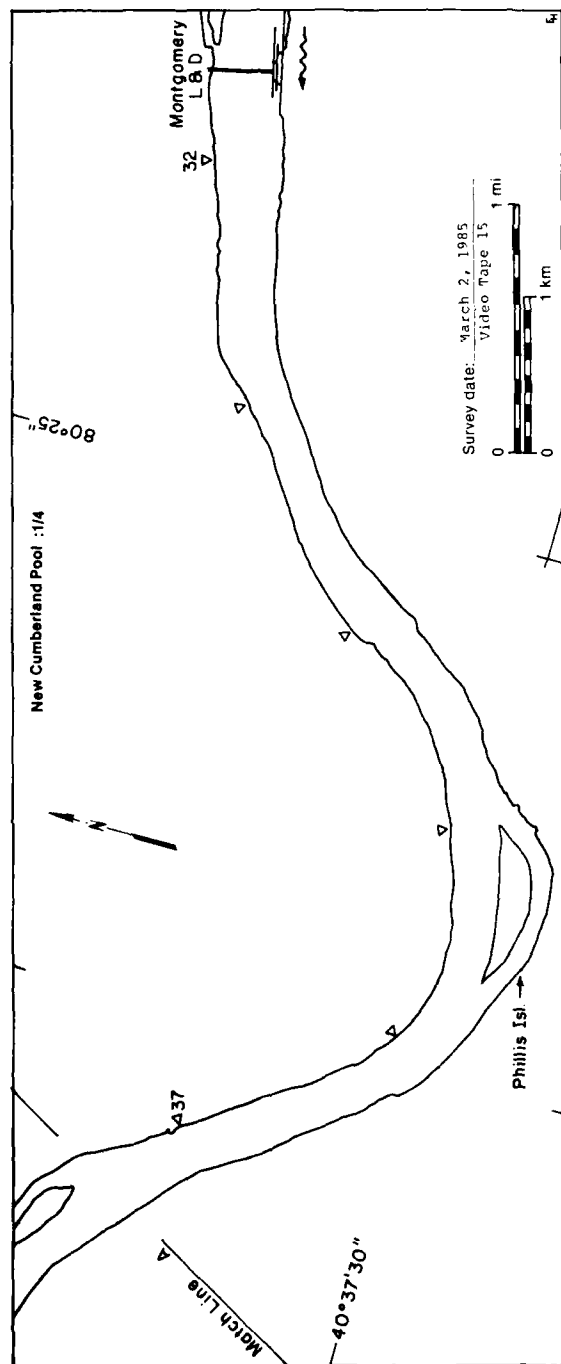


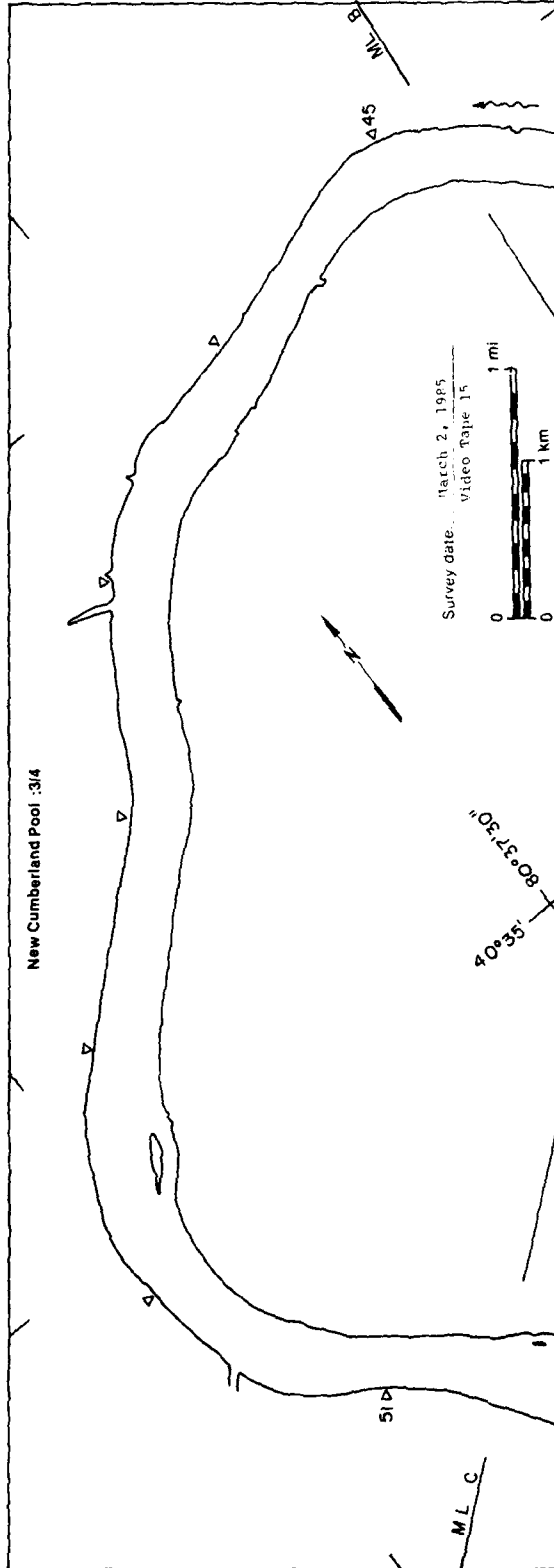
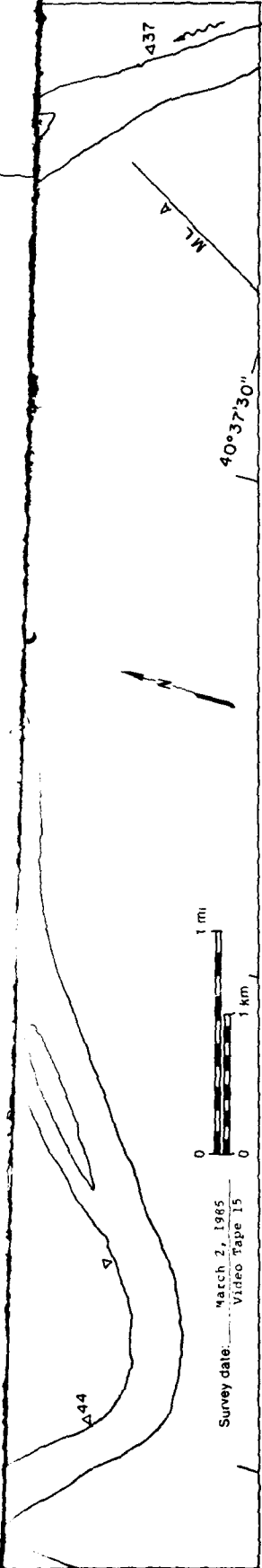
Montgomery Pool

MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	11.27	NA
Solid ice cover	---	NA
Solid ice cover with open-water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open-water areas	---	---
Ice floes or frazil slush and pans	---	---
Total Area (m ² x 10 ⁶)	11.27*	

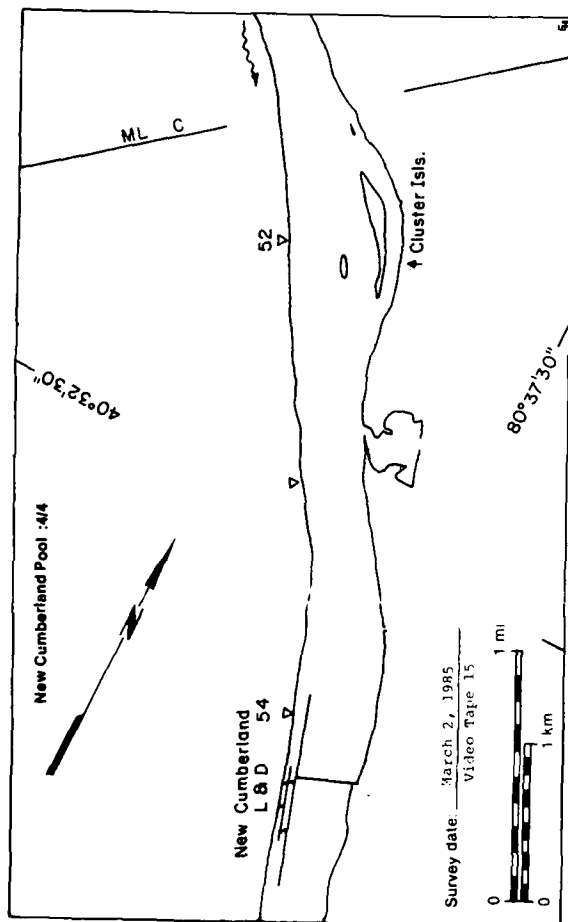
*Includes 6.24 no video coverage

2 March 1985



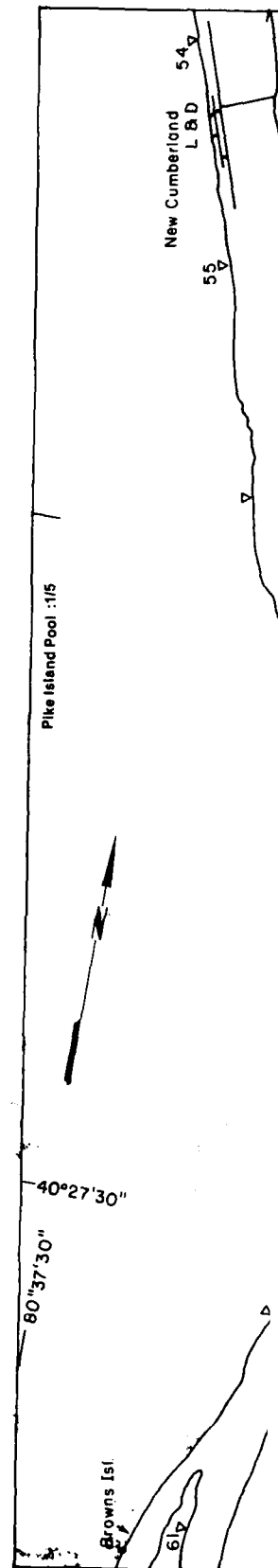


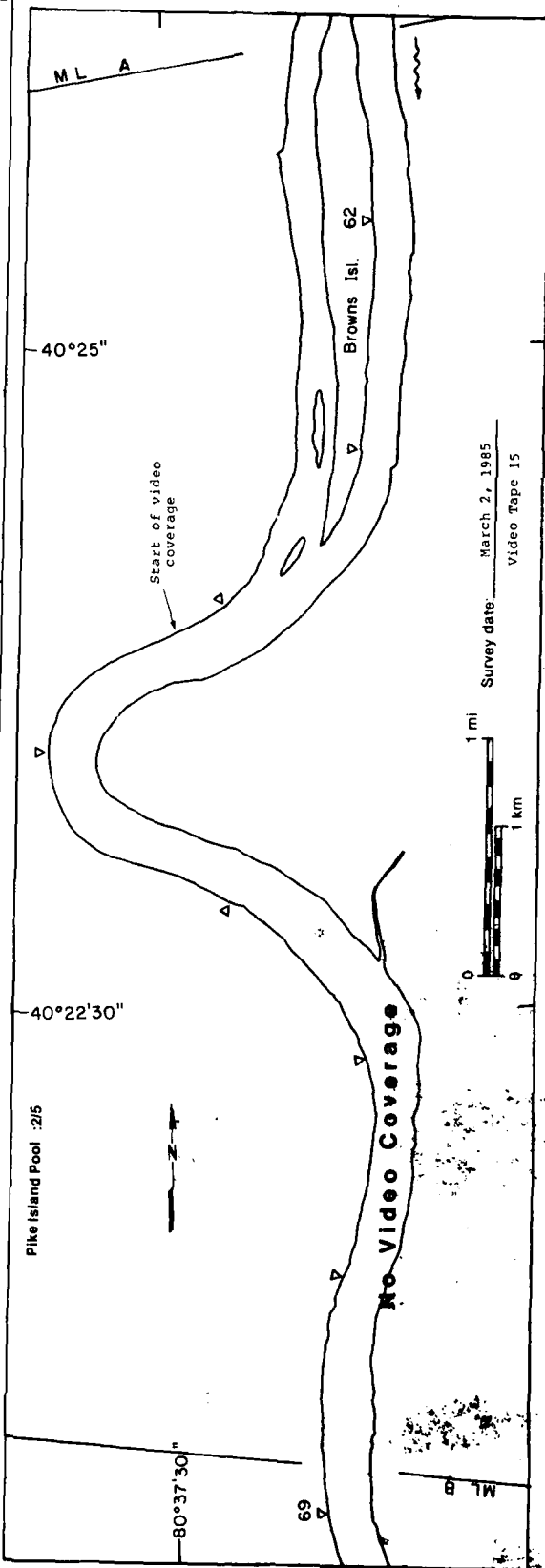
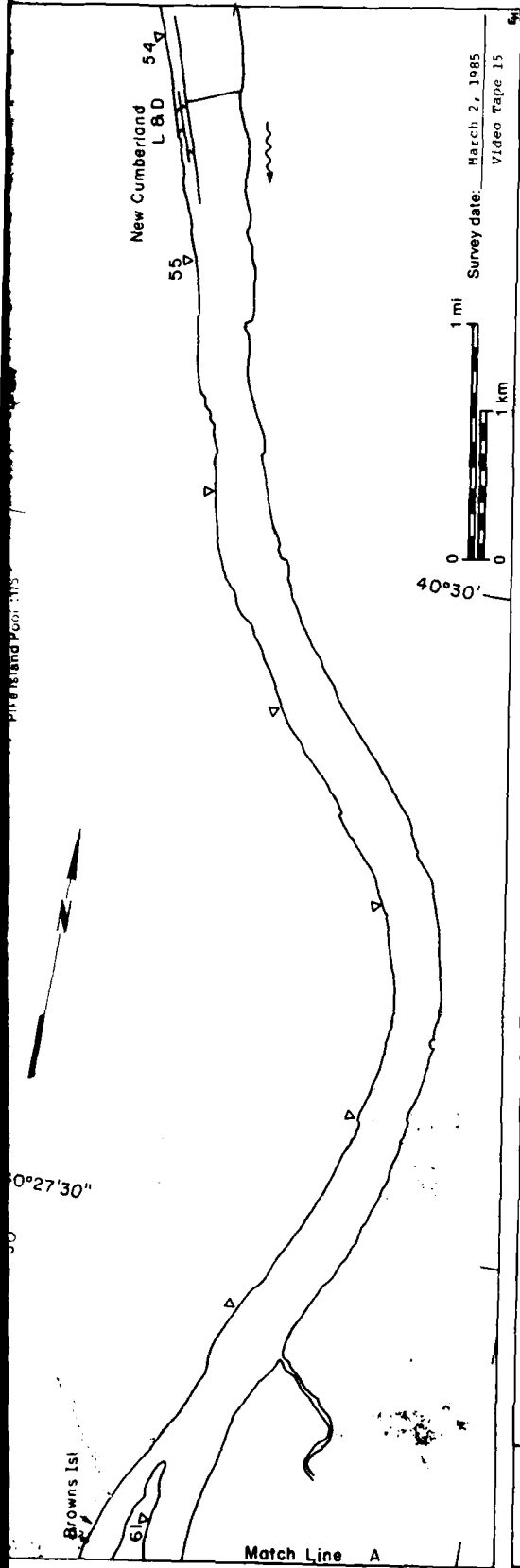
2 March 1985



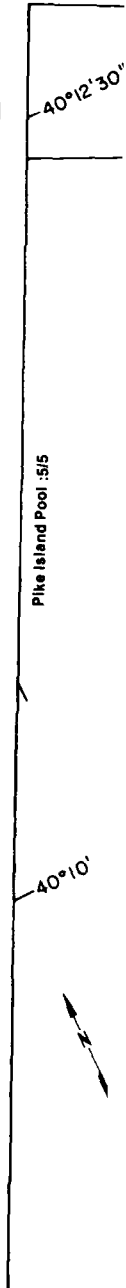
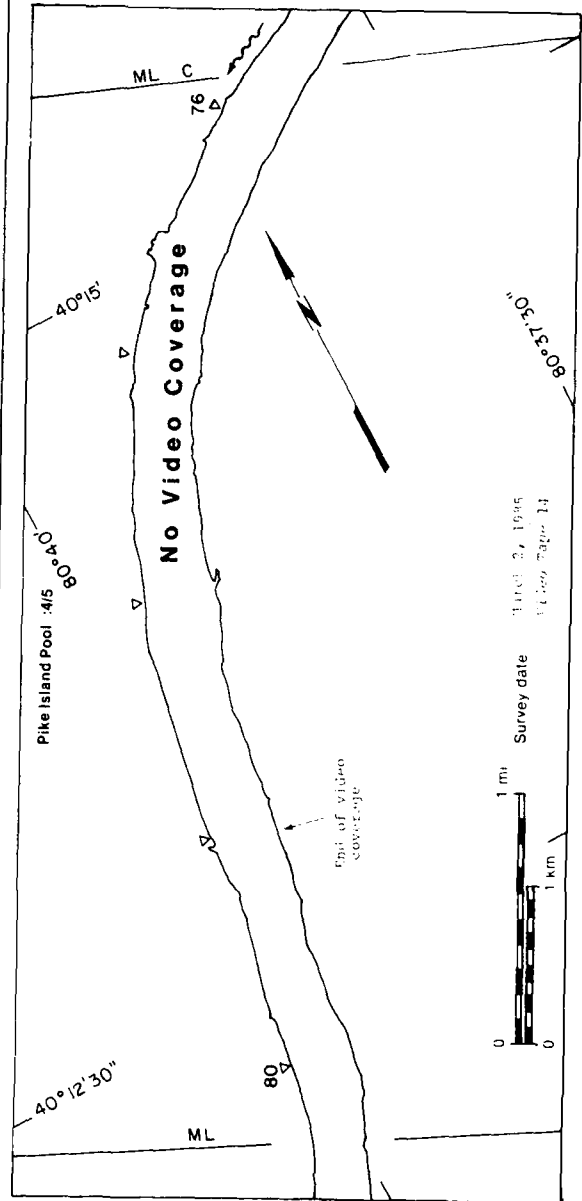
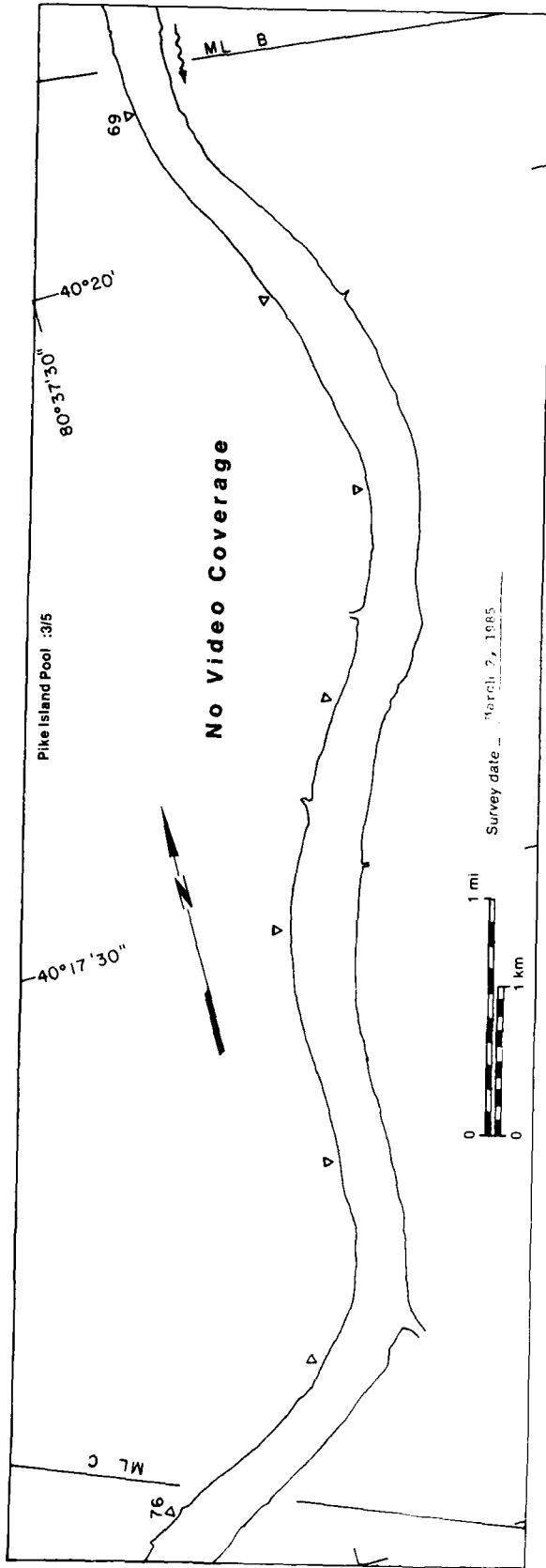
New Cumberland Pool

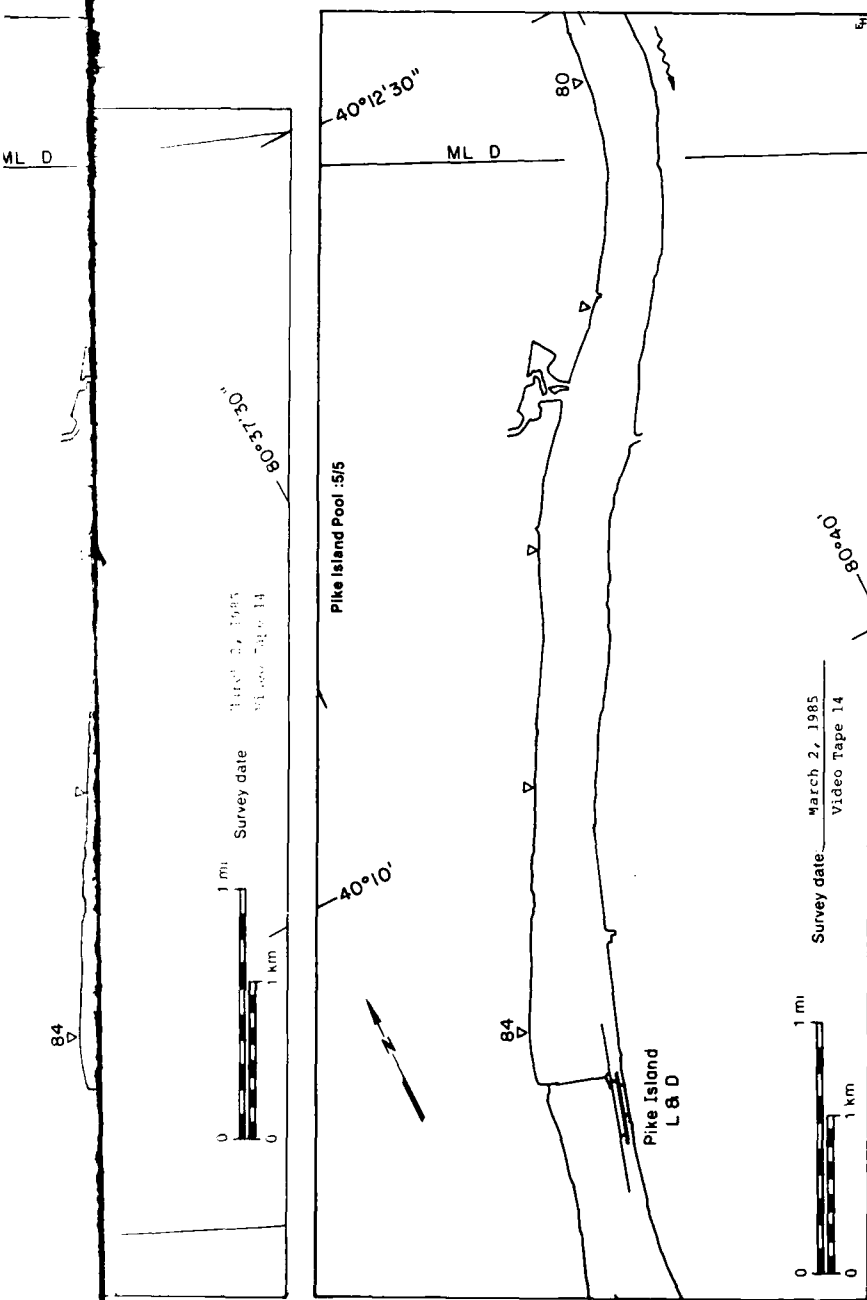
MAP UNITS	Area ($m^2 \times 10^6$)	Surface concentration (%)
Open water	14.87	NA
Solid ice cover	---	NA
Solid ice cover with open-water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open-water areas	---	---
Ice floes or frazil slush and pans	---	---
Total Area ($m^2 \times 10^6$)	14.87	





2 March 1985



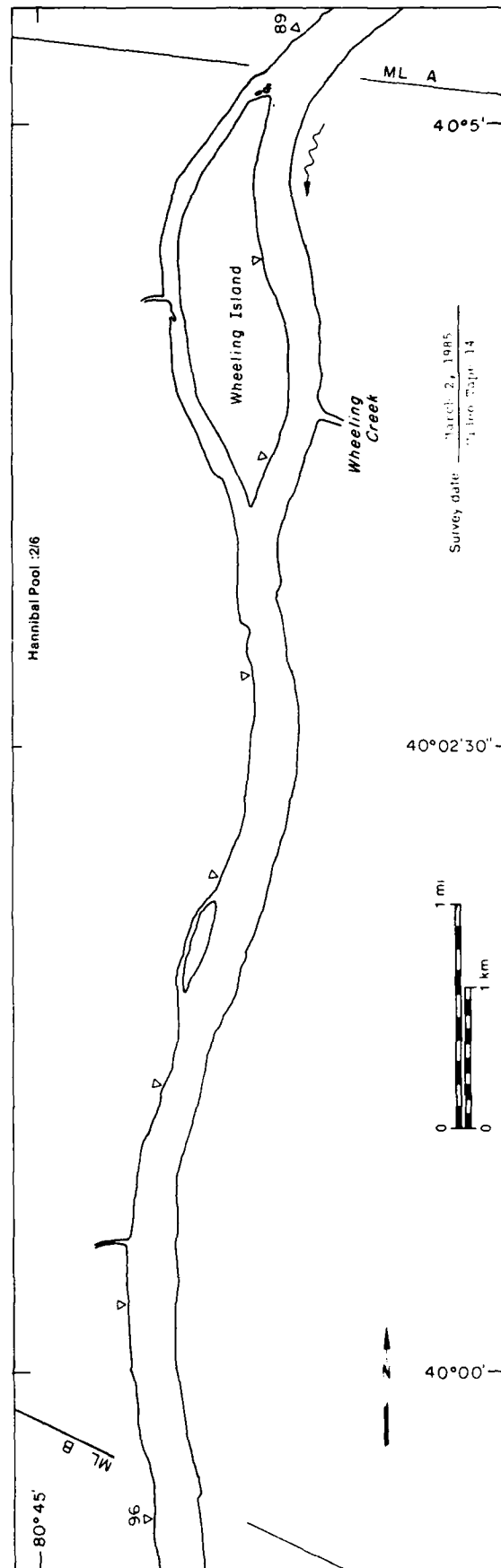
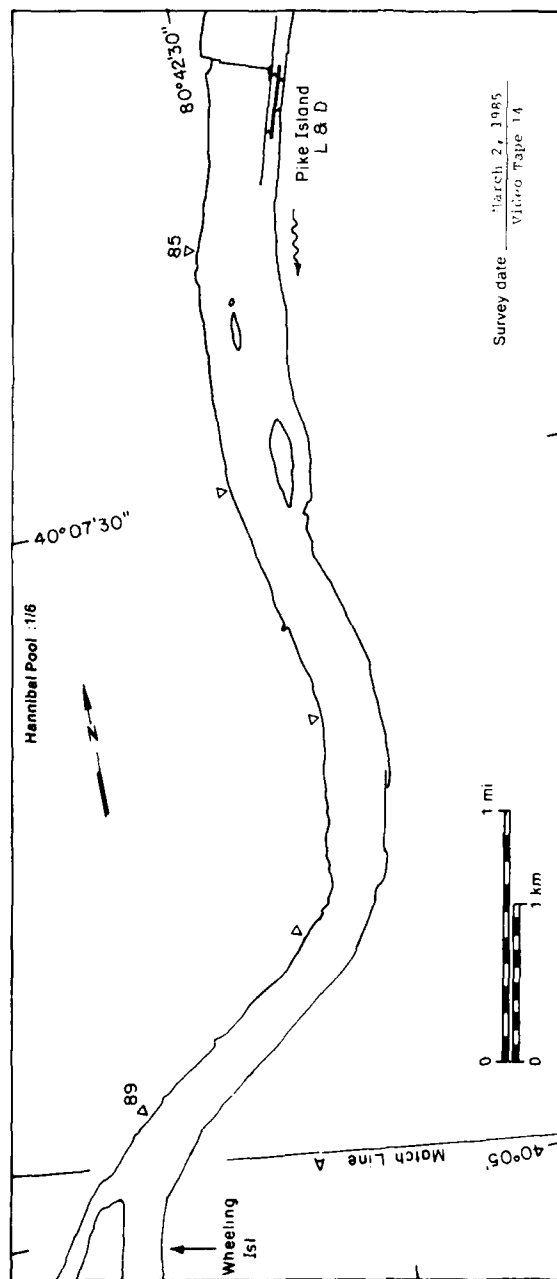


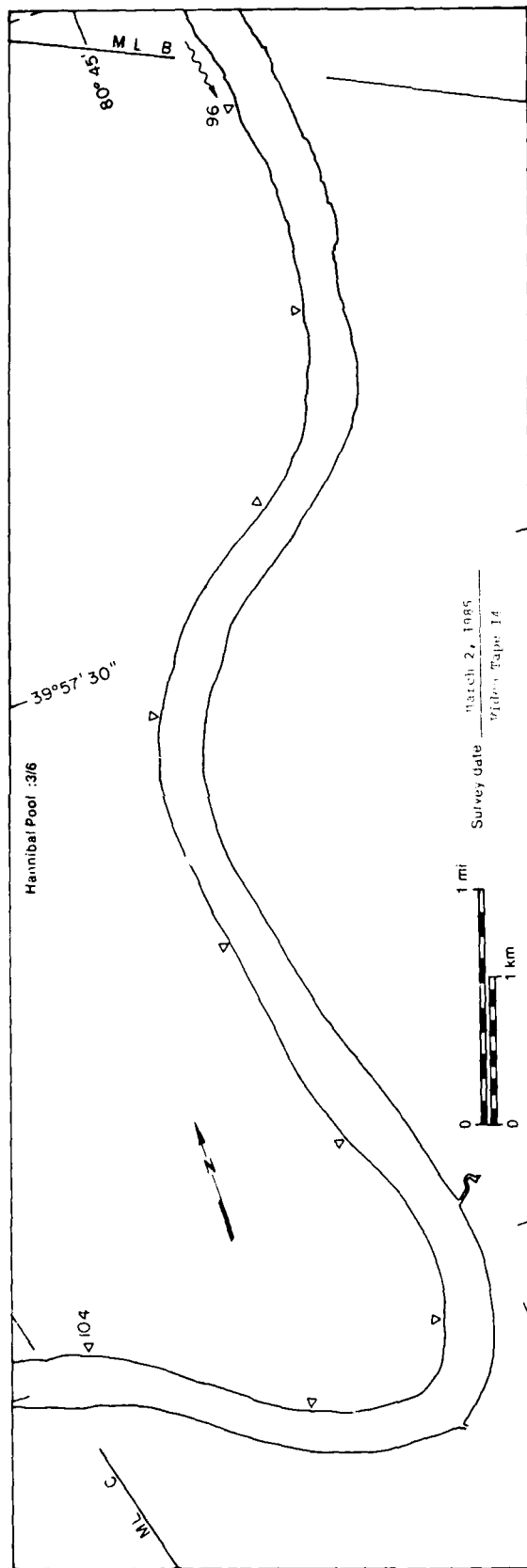
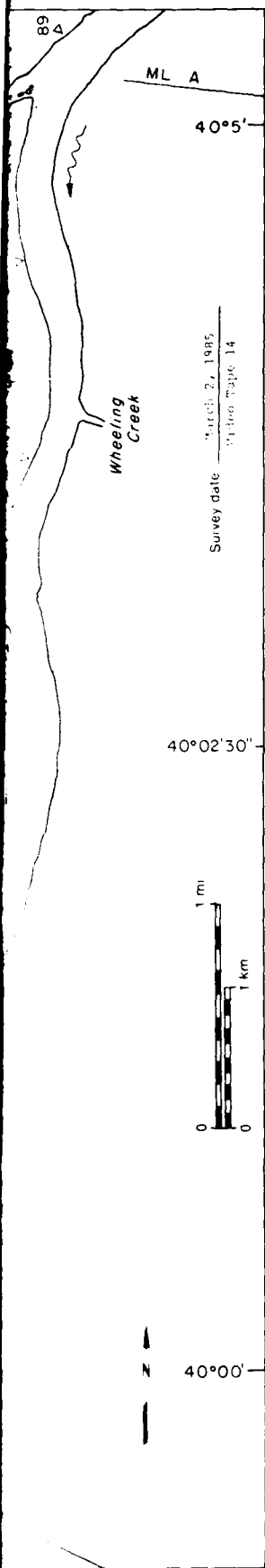
Pike Island Pool

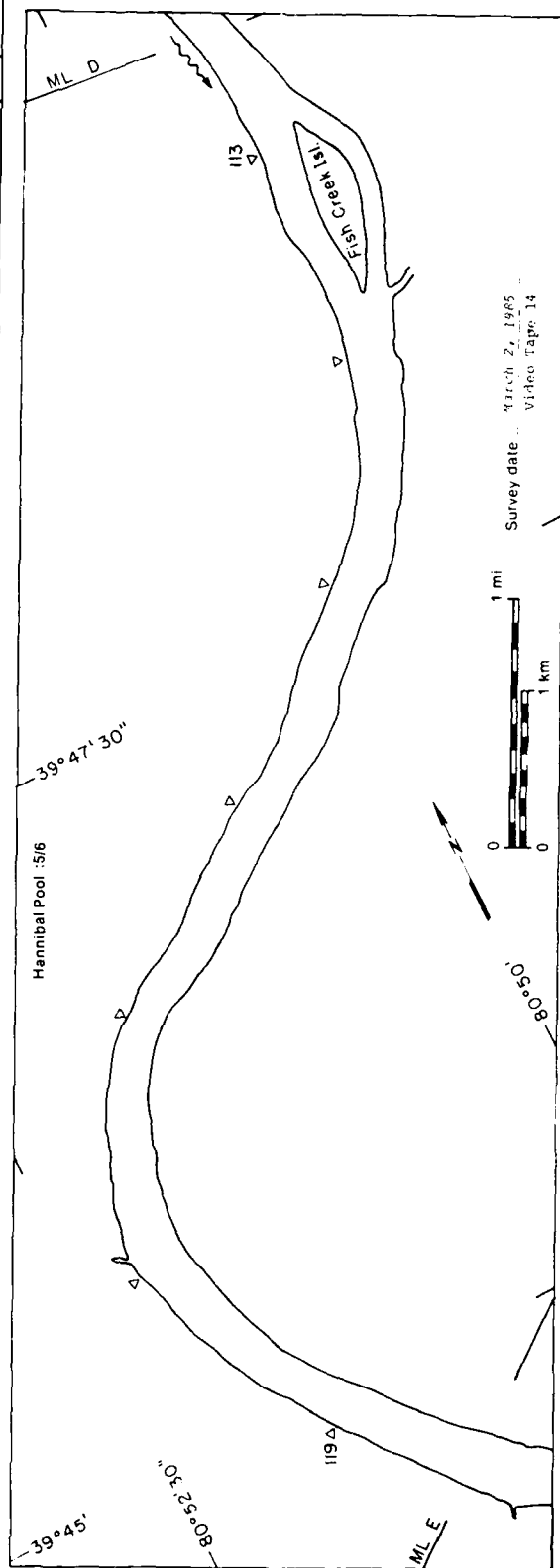
MAP UNITS	Area ² (m ² x 10 ⁶)	Surface concentration (%)
Open water	9.97	NA
Solid ice cover	---	NA
Solid ice cover with open-water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open-water areas	---	---
Ice floes or frazil slush and pans	---	---
Total Area (m² x 10⁶)	18.92*	

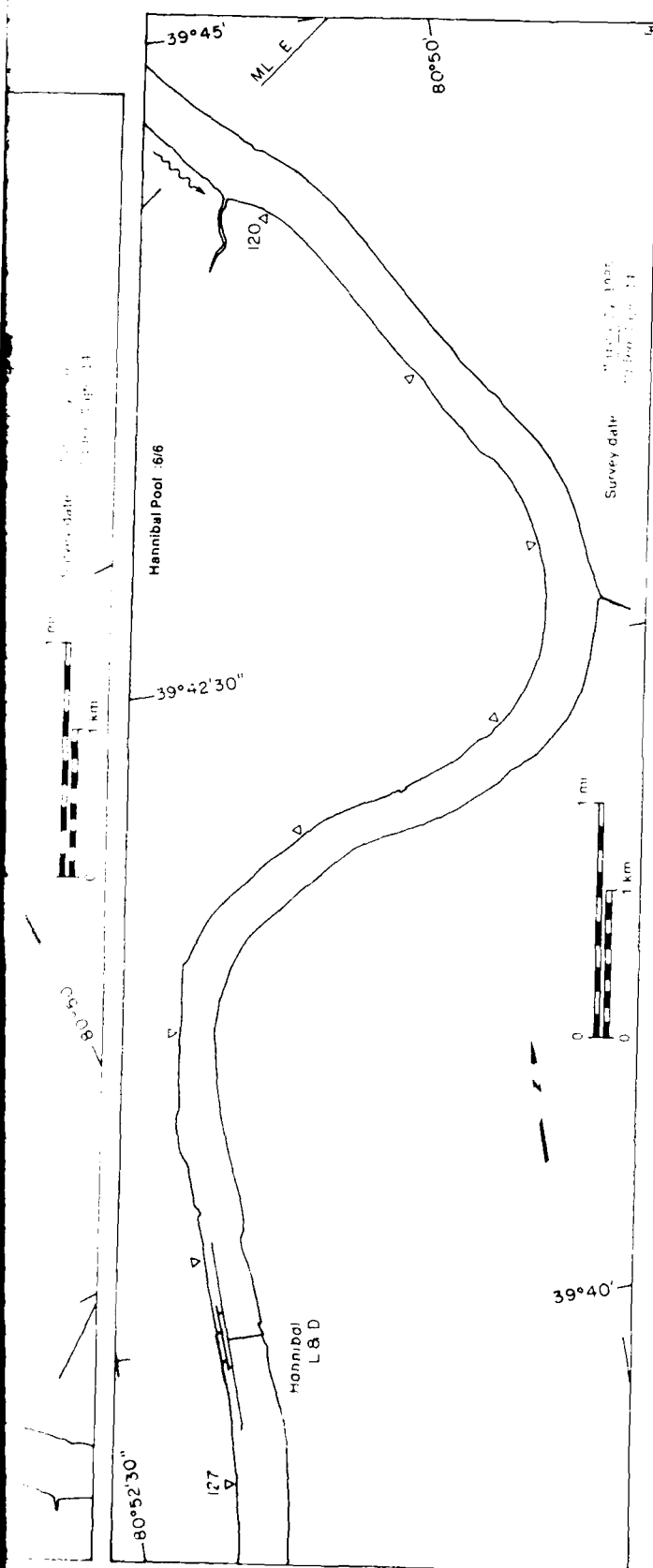
*Includes 8.95 no
video coverage

2 March 1985

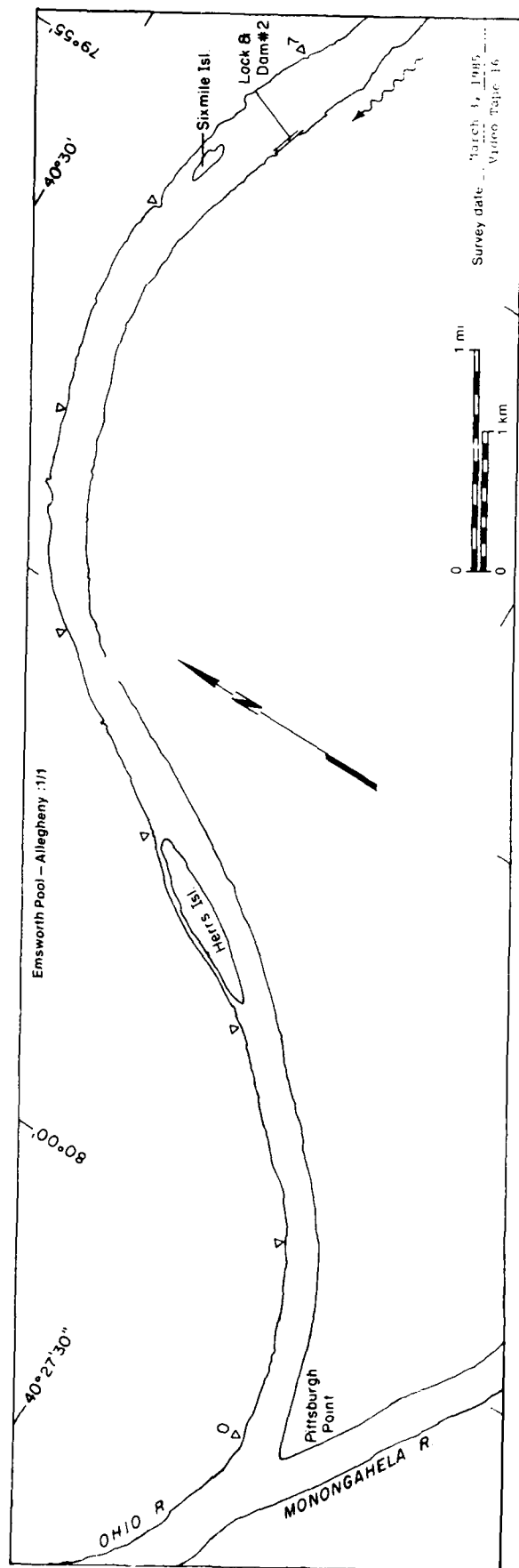






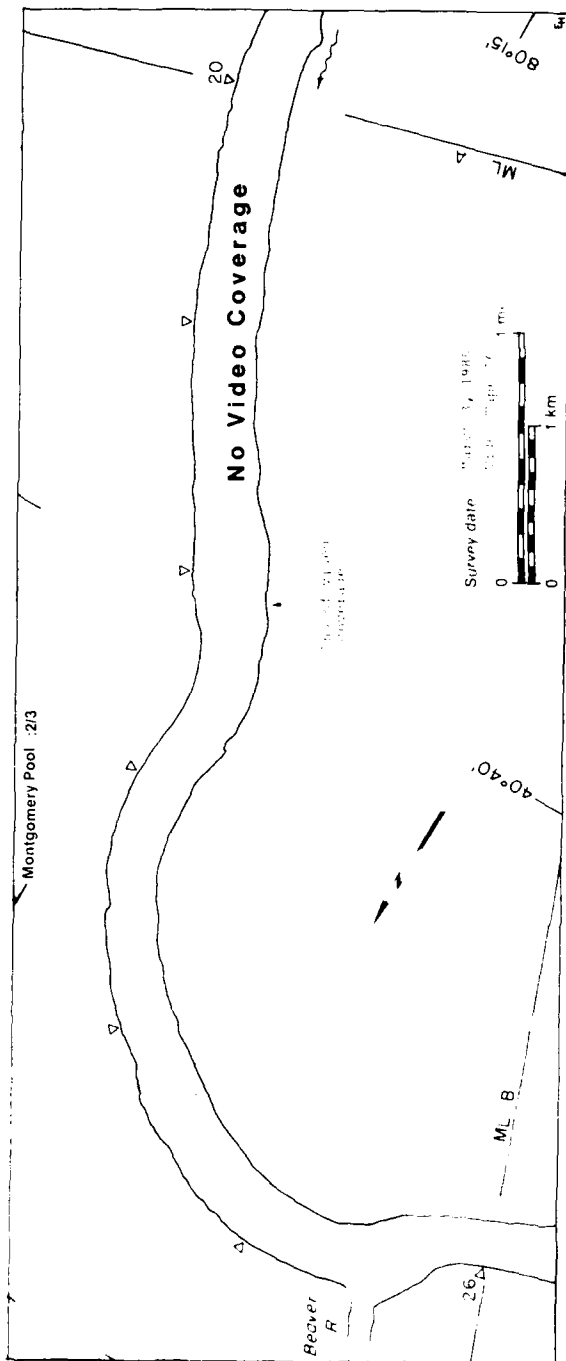
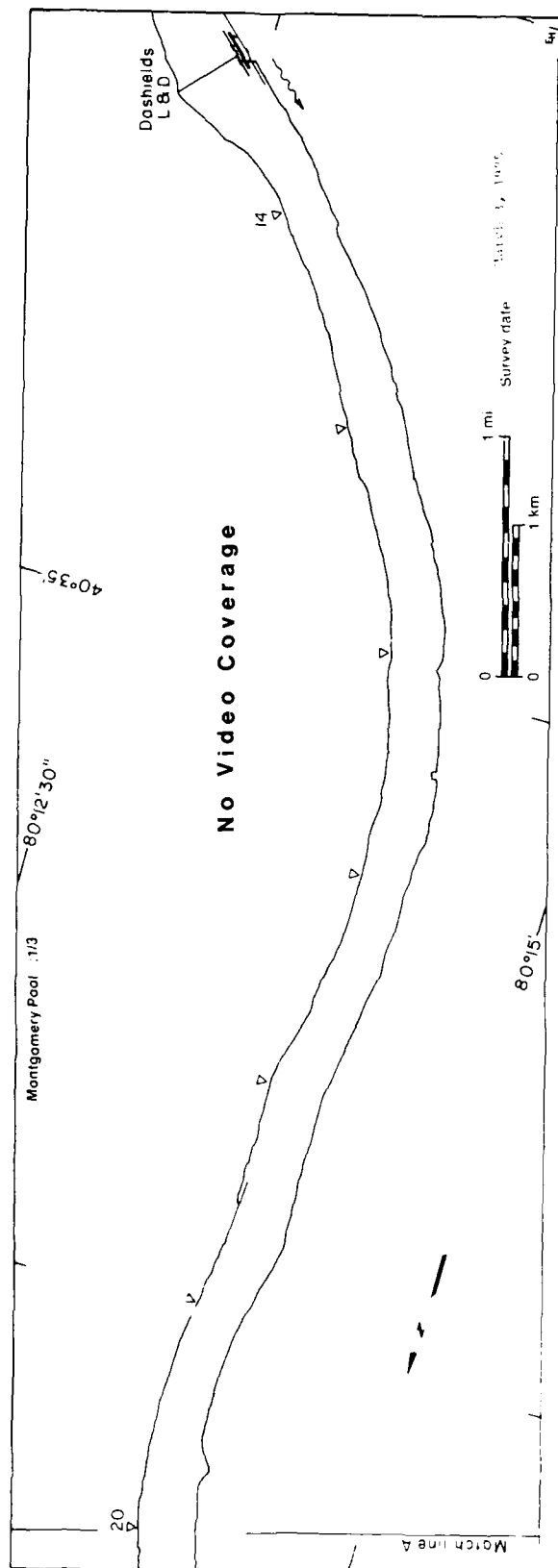
[illegible]

3 March 1985

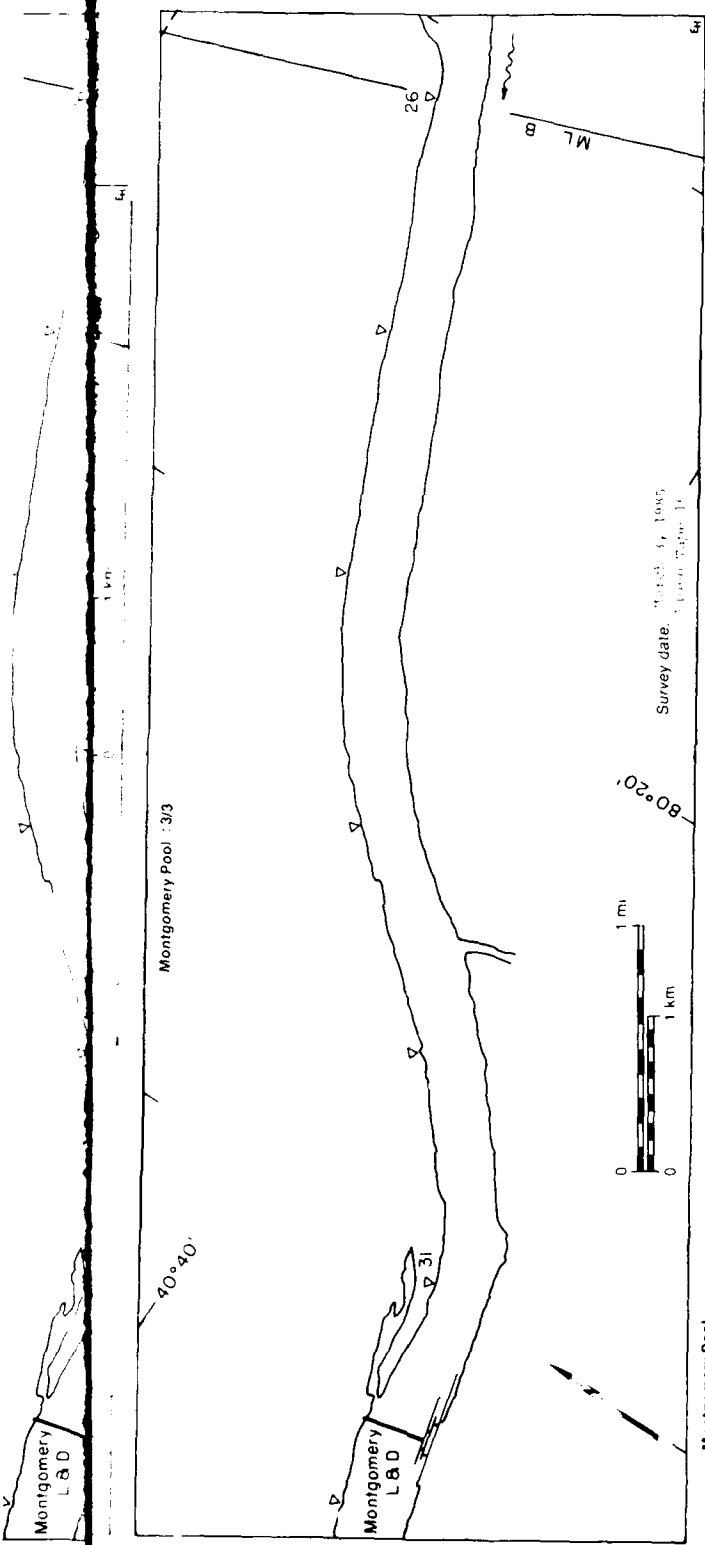


Map No.	Area 6_1 (sq. ft. x 10^6)	Surface concentration (g/l)
1	3.27	1.4
2	---	---
3	---	---
4	---	---
5	---	---
6	---	---
7	---	---
8	---	---
9	---	---
10	---	---
11	---	---
12	---	---
13	---	---
14	---	---
15	---	---
16	---	---
17	---	---
18	---	---
19	---	---
20	---	---
21	---	---
22	---	---
23	---	---
24	---	---
25	---	---
26	---	---
27	---	---
28	---	---
29	---	---
30	---	---
31	---	---
32	---	---
33	---	---
34	---	---
35	---	---
36	---	---
37	---	---
38	---	---
39	---	---
40	---	---
41	---	---
42	---	---
43	---	---
44	---	---
45	---	---
46	---	---
47	---	---
48	---	---
49	---	---
50	---	---
51	---	---
52	---	---
53	---	---
54	---	---
55	---	---
56	---	---
57	---	---
58	---	---
59	---	---
60	---	---
61	---	---
62	---	---
63	---	---
64	---	---
65	---	---
66	---	---
67	---	---
68	---	---
69	---	---
70	---	---
71	---	---
72	---	---
73	---	---
74	---	---
75	---	---
76	---	---
77	---	---
78	---	---
79	---	---
80	---	---
81	---	---
82	---	---
83	---	---
84	---	---
85	---	---
86	---	---
87	---	---
88	---	---
89	---	---
90	---	---
91	---	---
92	---	---
93	---	---
94	---	---
95	---	---
96	---	---
97	---	---
98	---	---
99	---	---
100	---	---
101	---	---
102	---	---
103	---	---
104	---	---
105	---	---
106	---	---
107	---	---
108	---	---
109	---	---
110	---	---
111	---	---
112	---	---
113	---	---
114	---	---
115	---	---
116	---	---
117	---	---
118	---	---
119	---	---
120	---	---
121	---	---
122	---	---
123	---	---
124	---	---
125	---	---
126	---	---
127	---	---
128	---	---
129	---	---
130	---	---
131	---	---
132	---	---
133	---	---
134	---	---
135	---	---
136	---	---
137	---	---
138	---	---
139	---	---
140	---	---
141	---	---
142	---	---
143	---	---
144	---	---
145	---	---
146	---	---
147	---	---
148	---	---
149	---	---
150	---	---
151	---	---
152	---	---
153	---	---
154	---	---
155	---	---
156	---	---
157	---	---
158	---	---
159	---	---
160	---	---
161	---	---
162	---	---
163	---	---
164	---	---
165	---	---
166	---	---
167	---	---
168	---	---
169	---	---
170	---	---
171	---	---
172	---	---
173	---	---
174	---	---
175	---	---
176	---	---
177	---	---
178	---	---
179	---	---
180	---	---
181	---	---
182	---	---
183	---	---
184	---	---
185	---	---
186	---	---
187	---	---
188	---	---
189	---	---
190	---	---
191	---	---
192	---	---
193	---	---
194	---	---
195	---	---
196	---	---
197	---	---
198	---	---
199	---	---
200	---	---
201	---	---
202	---	---
203	---	---
204	---	---
205	---	---
206	---	---
207	---	---
208	---	---
209	---	---
210	---	---
211	---	---
212	---	---
213	---	---
214	---	---
215	---	---
216	---	---
217	---	---
218	---	---
219	---	---
220	---	---
221	---	---
222	---	---
223	---	---
224	---	---
225	---	---
226	---	---
227	---	---
228	---	---
229	---	---
230	---	---
231	---	---
232	---	---
233	---	---
234	---	---
235	---	---
236	---	---
237	---	---
238	---	---
239	---	---
240	---	---
241	---	---
242	---	---
243	---	---
244	---	---
245	---	---
246	---	---
247	---	---
248	---	---
249	---	---
250	---	---
251	---	---
252	---	---
253	---	---
254	---	---
255	---	---
256	---	---
257	---	---
258	---	---
259	---	---
260	---	---
261	---	---
262	---	---
263	---	---
264	---	---
265	---	---
266	---	---
267	---	---
268	---	---
269	---	---
270	---	---
271	---	---
272	---	---
273	---	---
274	---	---
275	---	---
276	---	---
277	---	---
278	---	---
279	---	---
280	---	---
281	---	---
282	---	---
283	---	---
284	---	---
285	---	---
286	---	---
287	---	---
288	---	---
289	---	---
290	---	---
291	---	---
292	---	---
293	---	---
294	---	---
295	---	---
296	---	---
297	---	---
298	---	---
299	---	---
300	---	---
301	---	---
302	---	---
303	---	---
304	---	---
305	---	---
306	---	---
307	---	---
308	---	---
309	---	---
310	---	---
311	---	---
312	---	---
313	---	---
314	---	---
315	---	---
316	---	---
317	---	---
318	---	---
319	---	---
320	---	---
321	---	---
322	---	---
323	---	---
324	---	---
325	---	---
326	---	---
327	---	---
328	---	---
329	---	---
330	---	---
331	---	---
332	---	---
333	---	---
334	---	---
335	---	---
336	---	---
337	---	---
338	---	---
339	---	---
340	---	---
341	---	---
342	---	---
343	---	---
344	---	---
345	---	---
346	---	---
347	---	---
348	---	---
349	---	---
350	---	---
351	---	---
352	---	---
353	---	---
354	---	---
355	---	---
356	---	---
357	---	---
358	---	---
359	---	---
360	---	---
361	---	---
362	---	---
363	---	---
364	---	---
365	---	---
366	---	---
367	---	---
368	---	---
369	---	---
370	---	---
371	---	---
372	---	---
373	---	---
374	---	---
375	---	---
376	---	---
377	---	---
378	---	---
379	---	---
380	---	---
381	---	---
382	---	---
383	---	---
384	---	---
385	---	---
386	---	---
387	---	---
388	---	---
389	---	---
390	---	---
391	---	---
392	---	---
393	---	---
394	---	---
395	---	---
396	---	---
397	---	---
398	---	---
399	---	---
400	---	---
401	---	---
402	---	---
403	---	---
404	---	---
405	---	---
406	---	---
407	---	---
408	---	---
409	---	---
410	---	---
411	---	---
412	---	---
413	---	---
414	---	---
415	---	---
416	---	---
417	---	---
418	---	---
419	---	---
420	---	---
421	---	---
422	---	---
423	---	---
424	---	---
425	---	---
426	---	---
427	---	---
428	---	---
429	---	---
430	---	---
431	---	---
432	---	---
433	---	---
434	---	---
435	---	---
436	---	---
437	---	---
438	---	---
439	---	---
440	---	---
441	---	---
442	---	---
443	---	---
44		

3 March 1985



Montgomery Pool : 3/3



Montgomery Pool

MAP UNITS

- Open water
- Solid ice cover
- Solid ice cover with open water areas
- Fragmented ice cover
- Fragmented ice cover with open water areas
- Locations of "ice" slush and leads

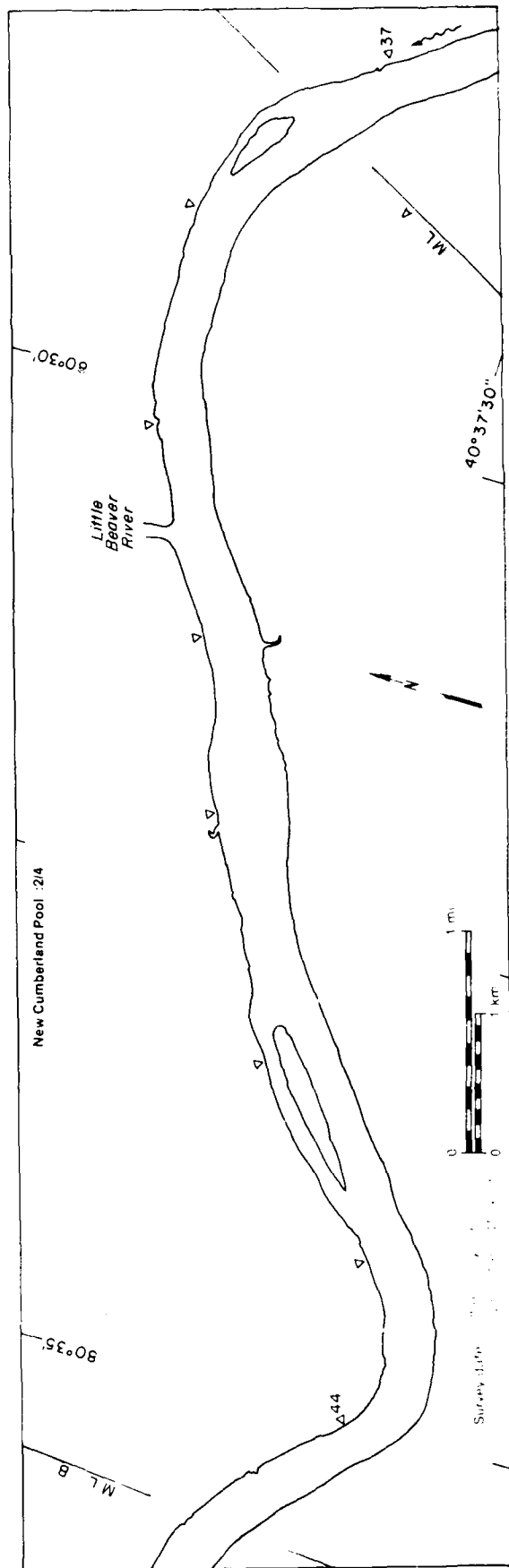
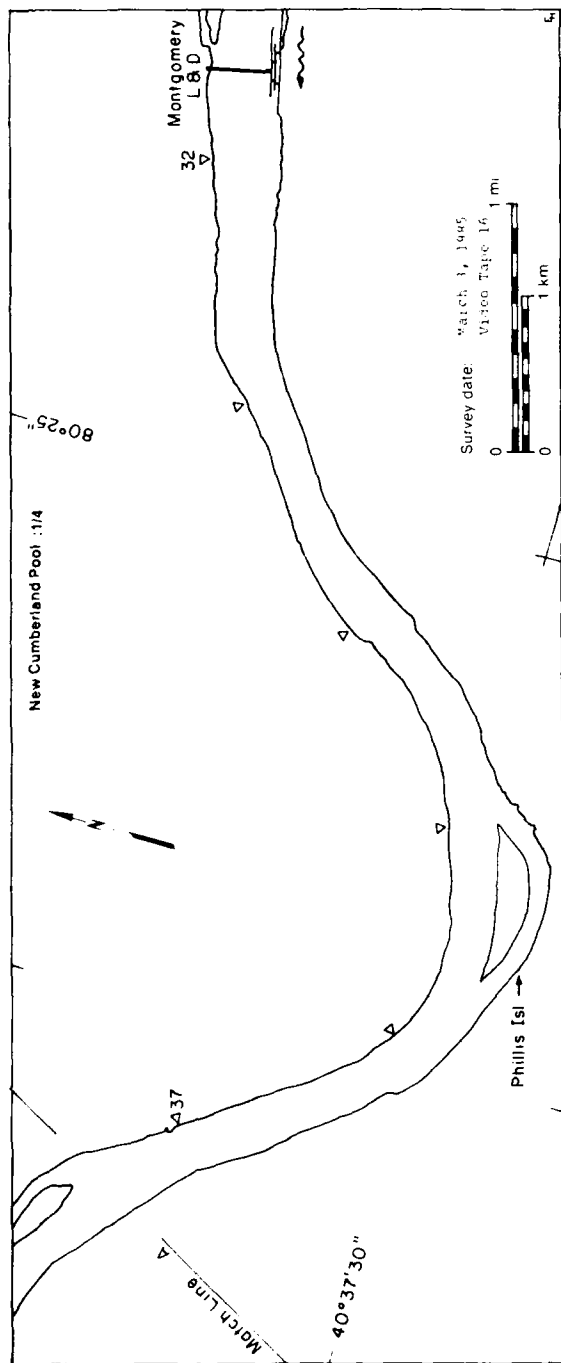
Surface concentration
(%)

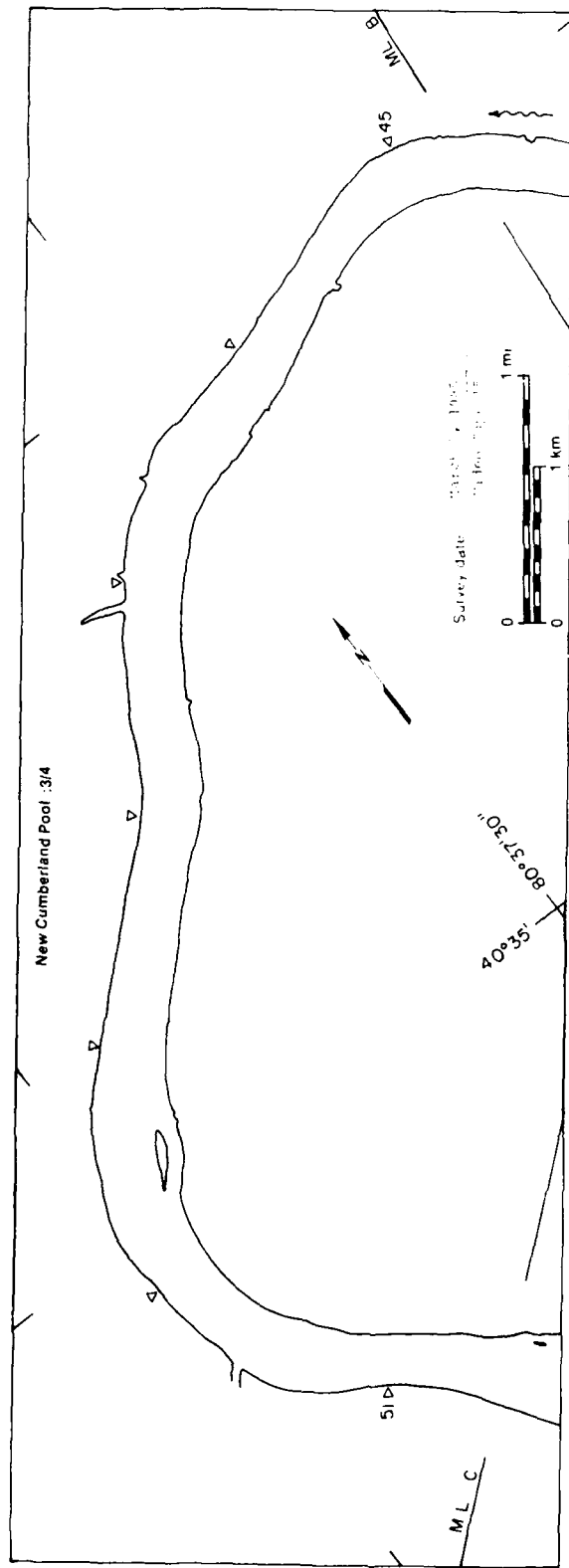
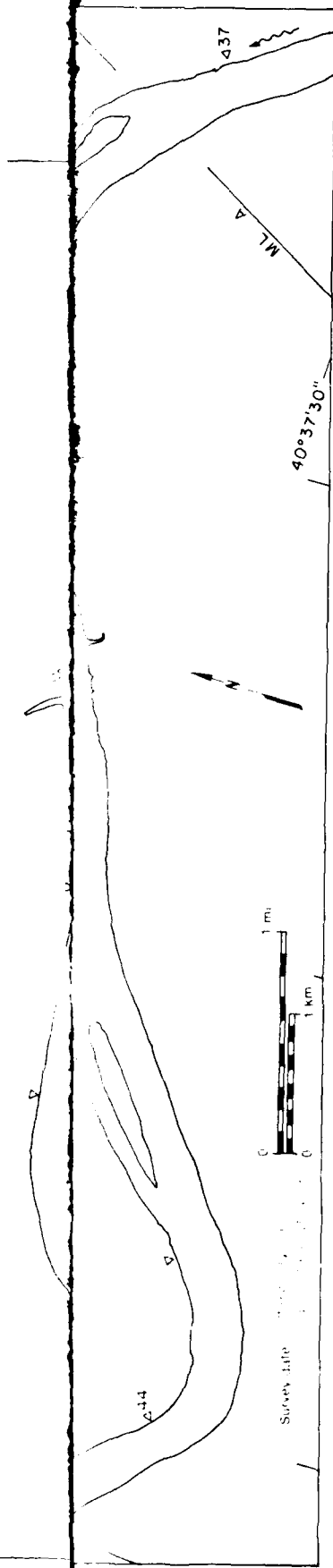
0.00	NA
0.00	NA
0.00	---
0.00	NA
0.00	---
0.00	---
0.00	---

* The above values are
values only

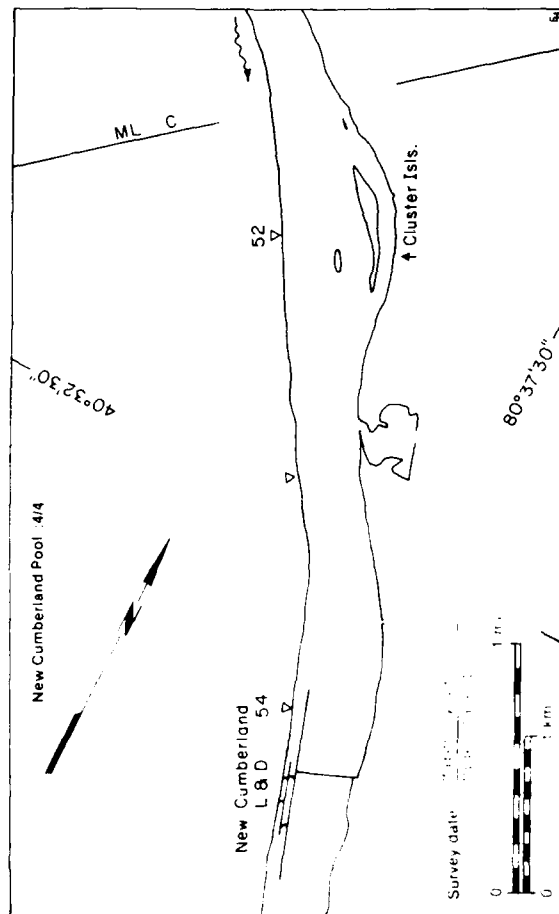
Scale: 1:100,000

3 March 1985



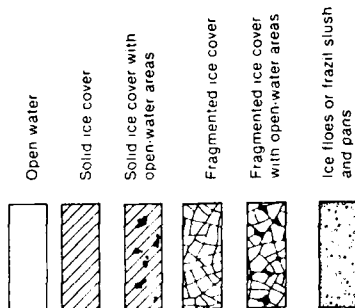


3 March 1985



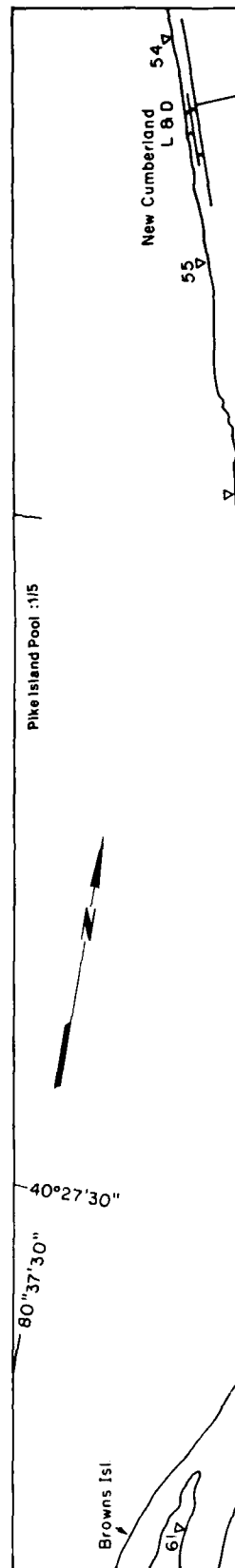
New Cumberland Pool

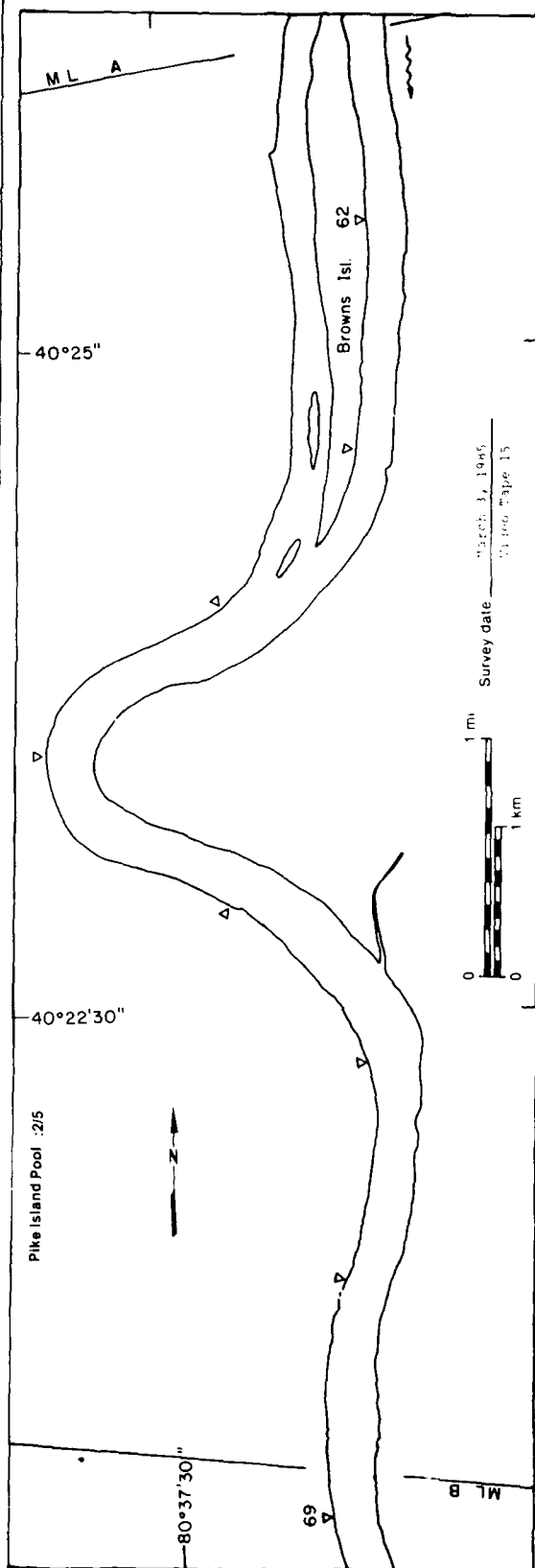
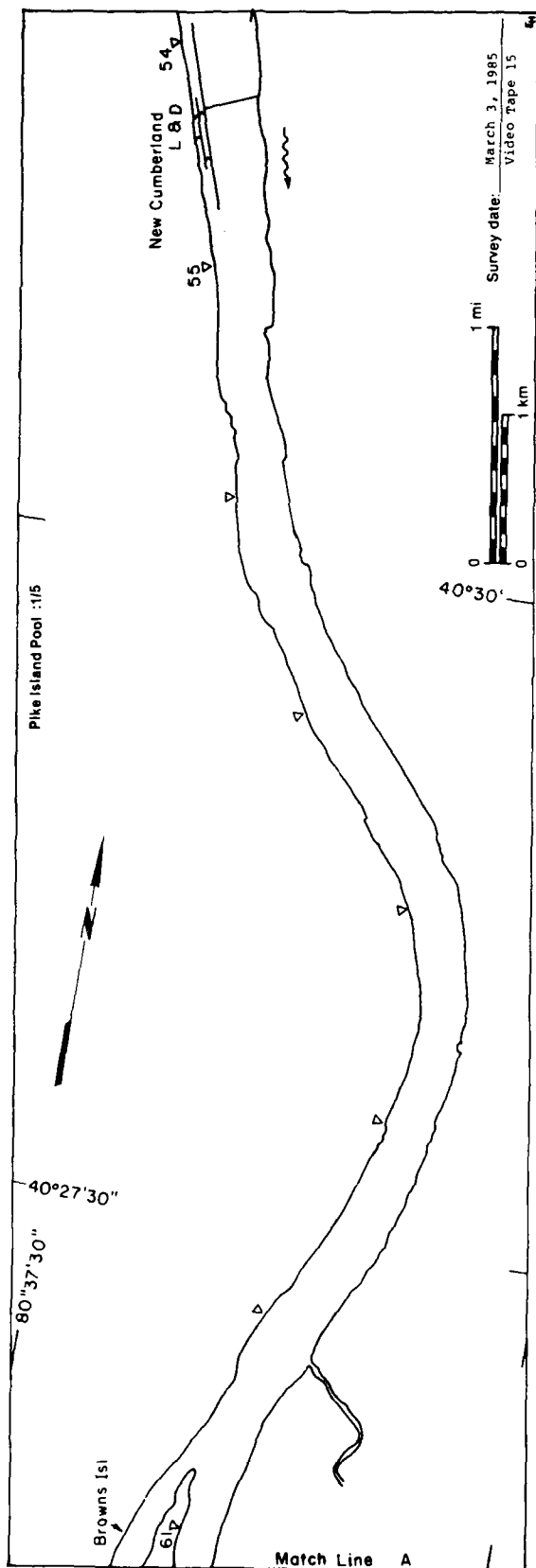
MAP UNITS



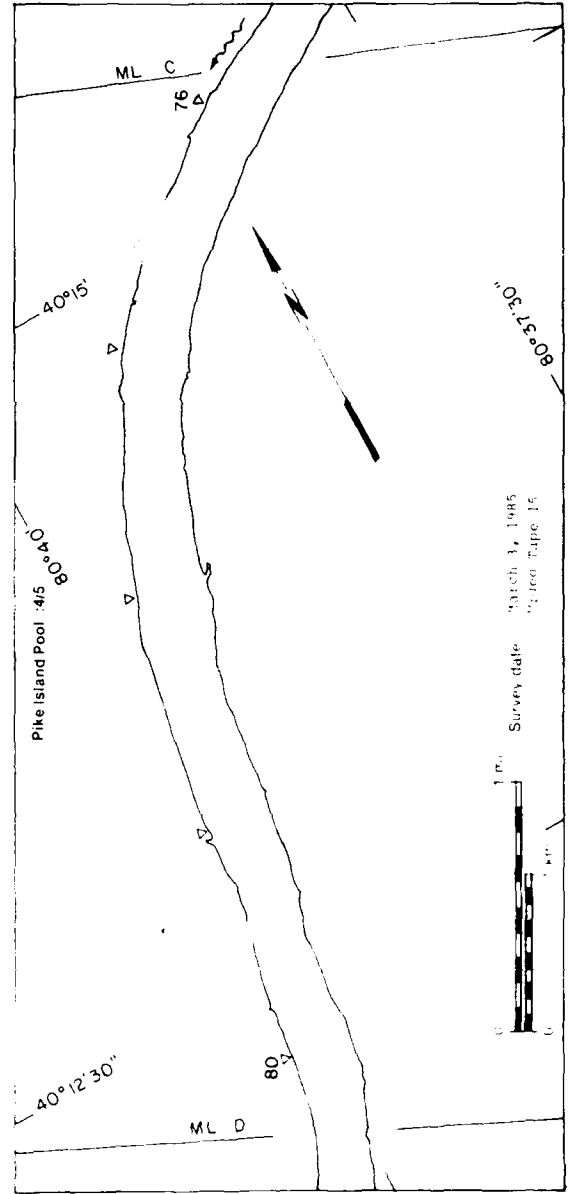
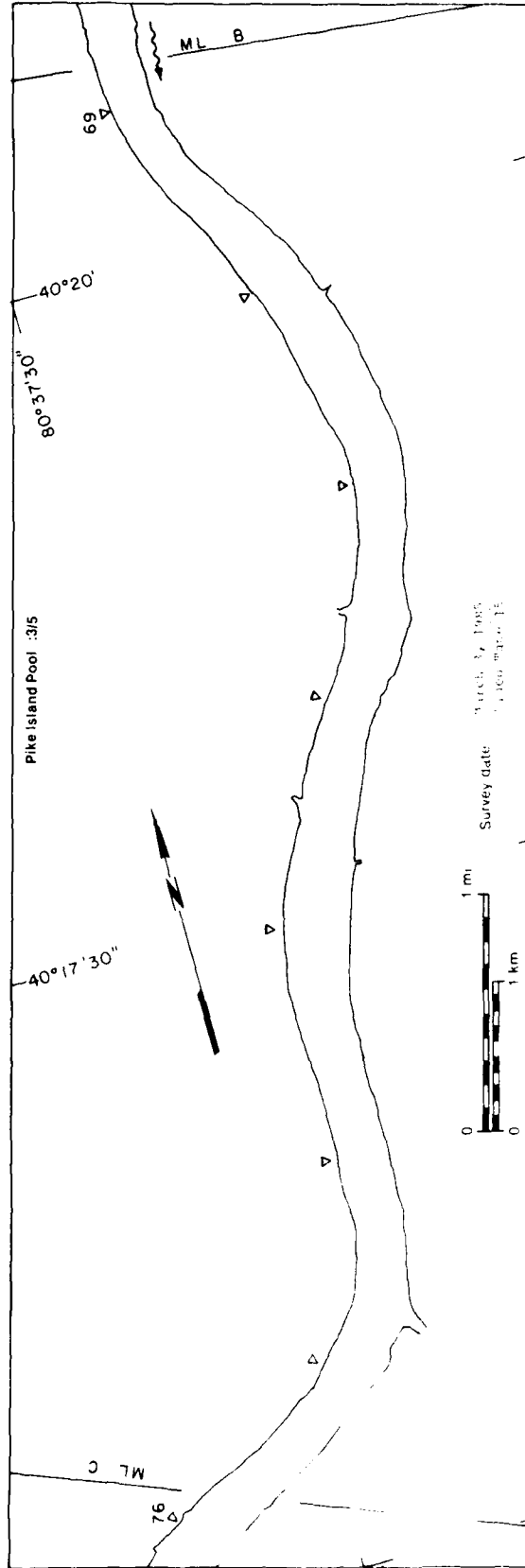
Area (m ² x 10 ⁶)	Surface concentration (%)
14.87	NA
---	NA
---	---
---	NA
---	---
---	---
14.87	---

Total Area (m² x 10⁶)





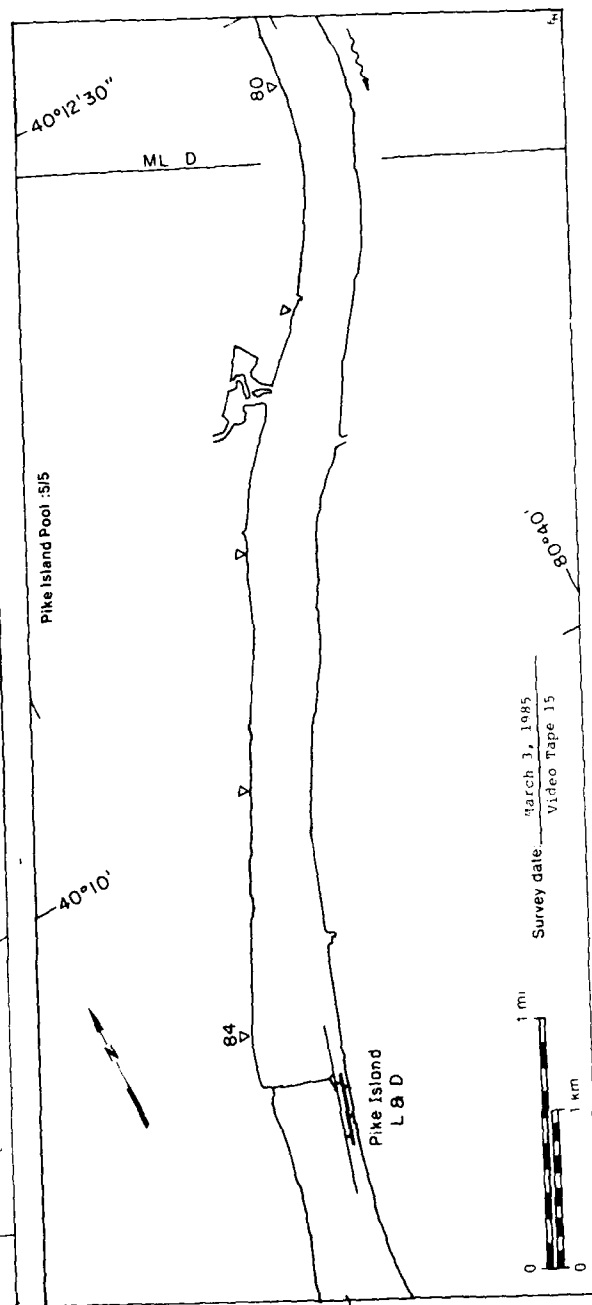
3 March 1985



ML D

84

Survey date March 3, 1985
Video Tape 15

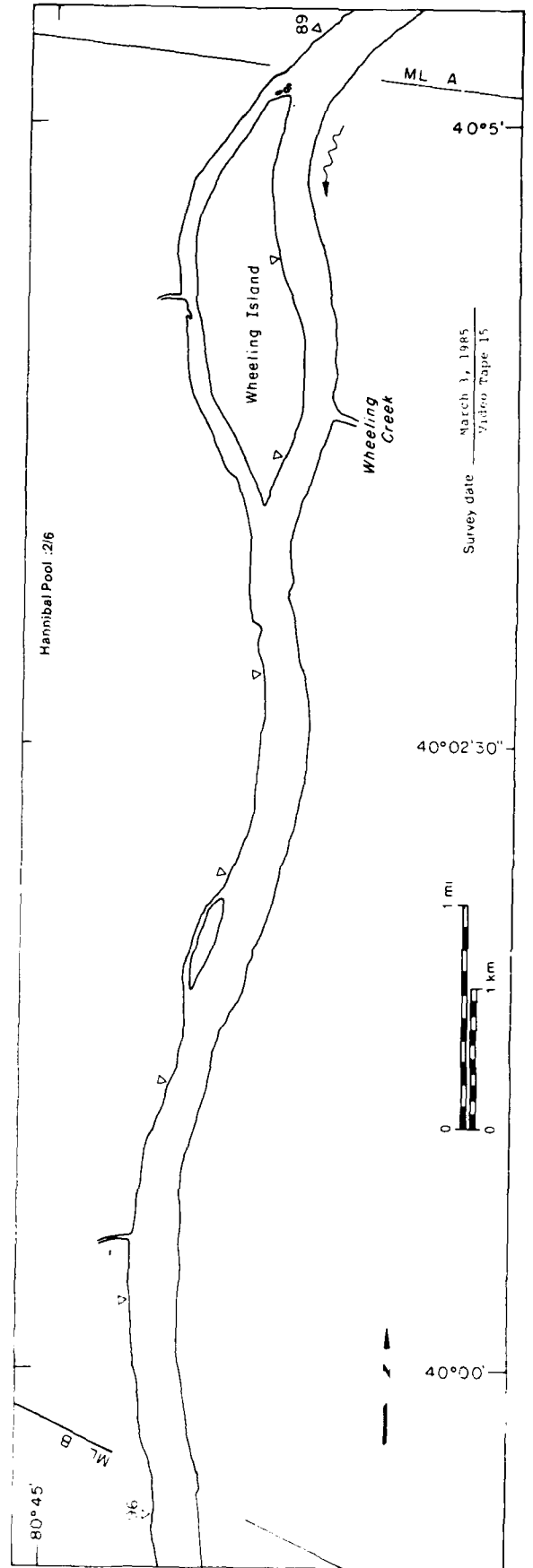
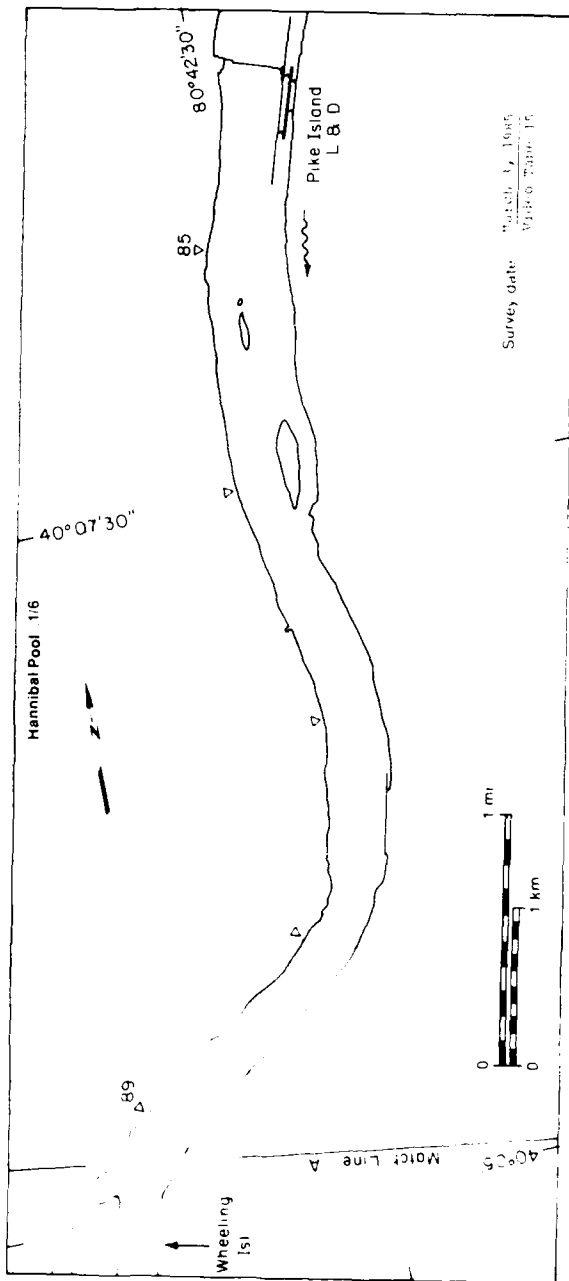


Survey date March 3, 1985
Video Tape 15

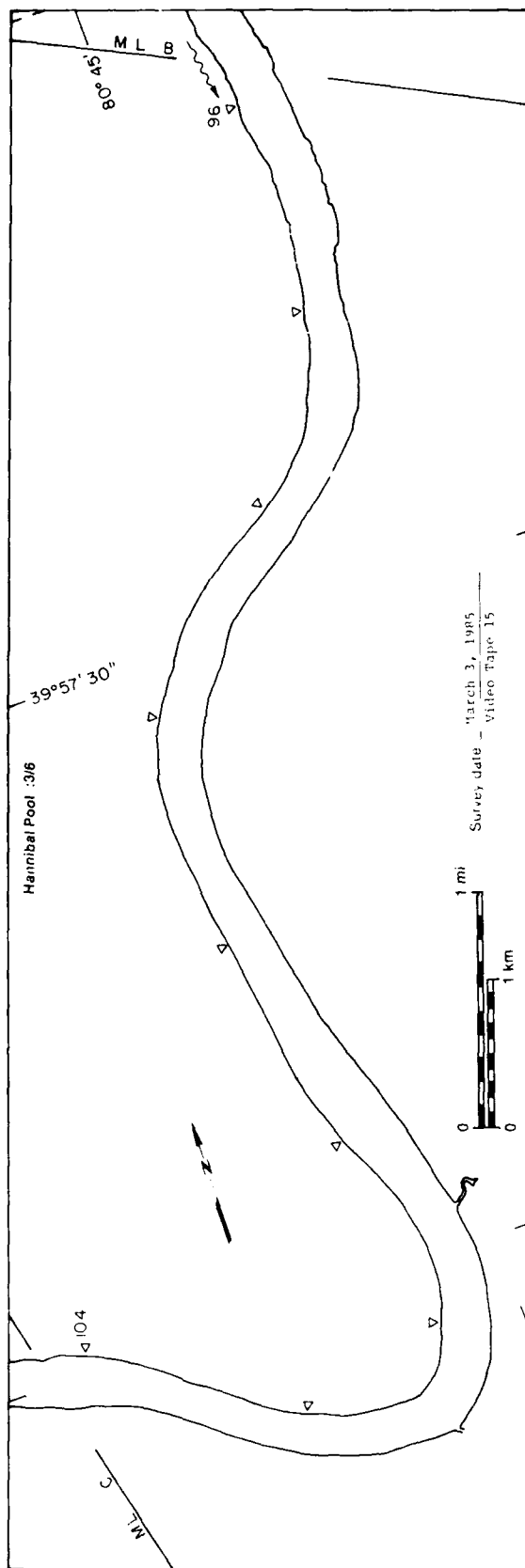
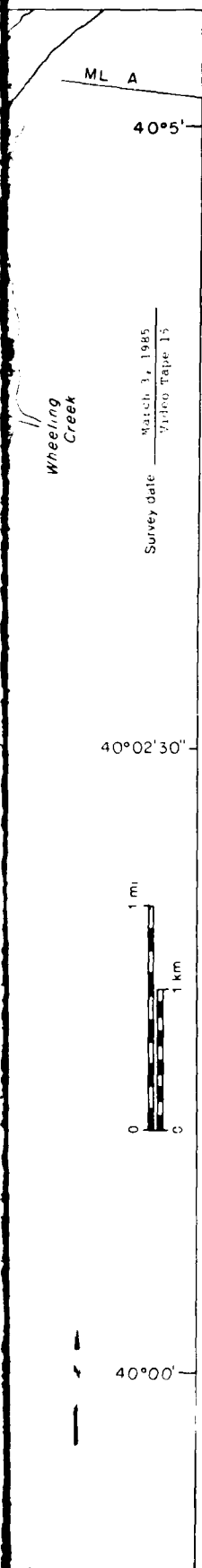


Pike Island Pool	
MAP UNITS	Surface concentration (%)
Open water	NA
Solid ice cover	NA
Solid ice cover with open water areas	--
Fragmented ice cover	NA
Fragmented ice cover with open water areas	--
Ice floes or frazil slush and pans	--
Total Area (m ² x 10 ⁶)	18.92

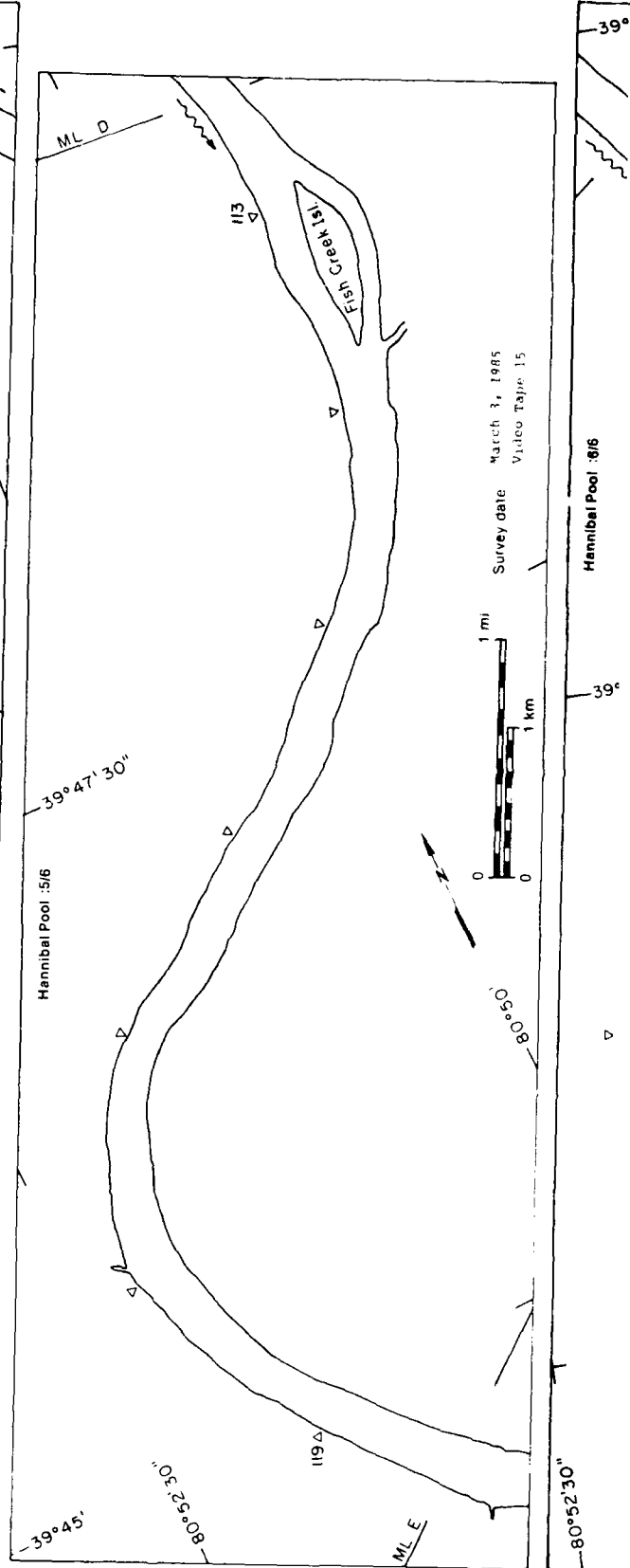
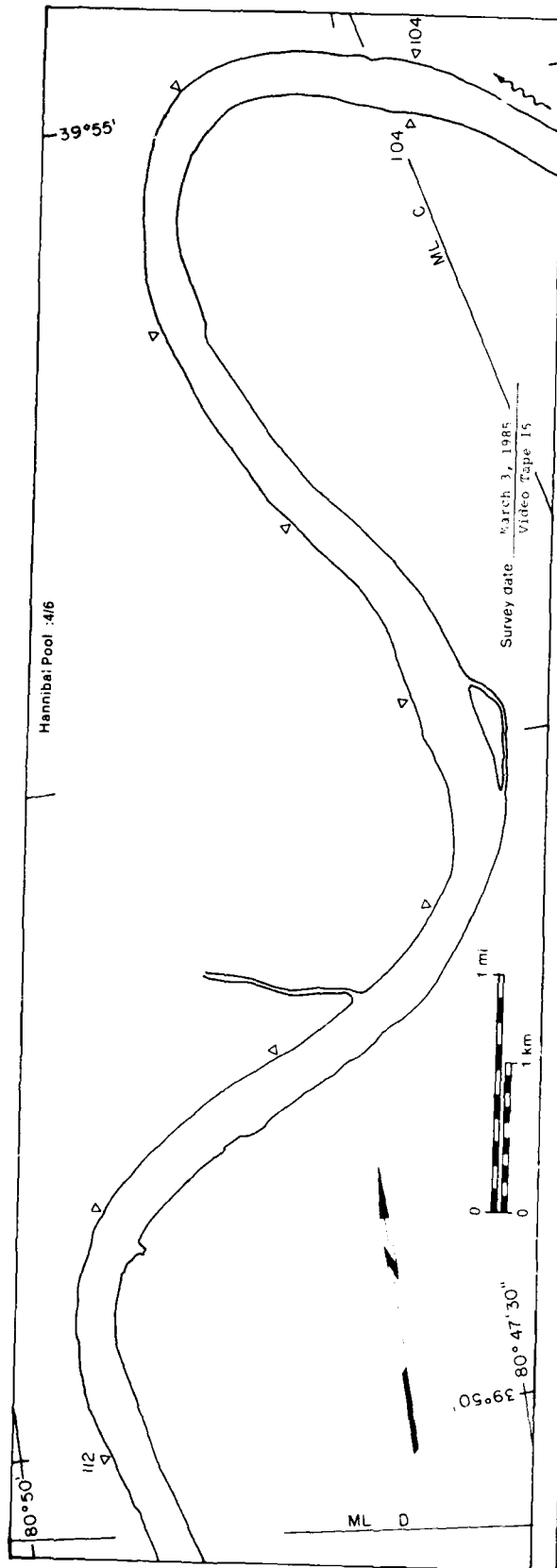
3 March 1985



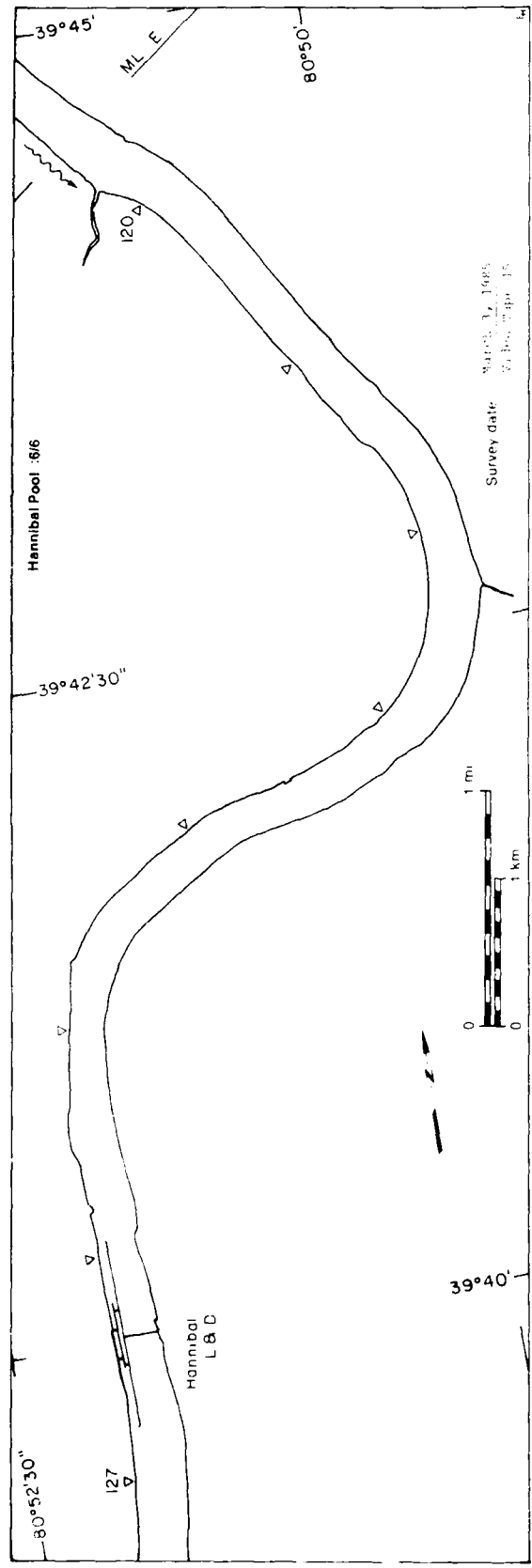
Survey date March 3, 1985
Video Tape 15



3 March 1985



Survey date: March 14, 1985
 Station: 1000

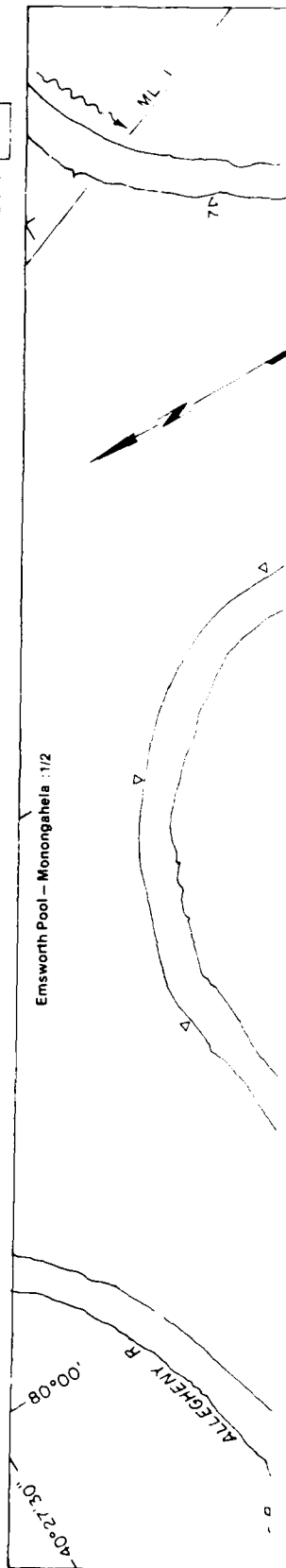


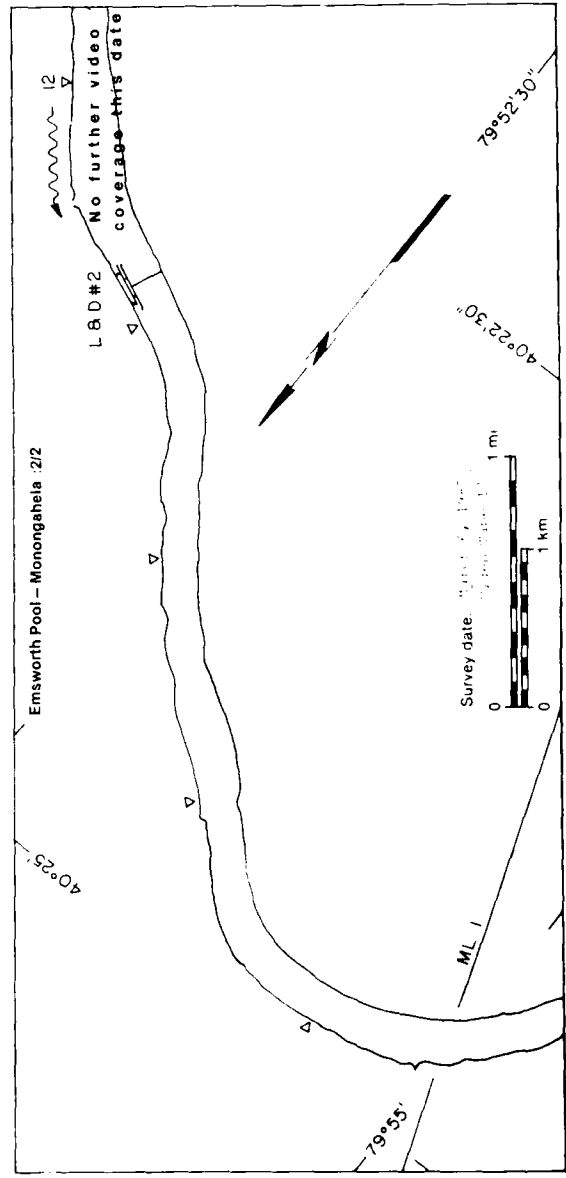
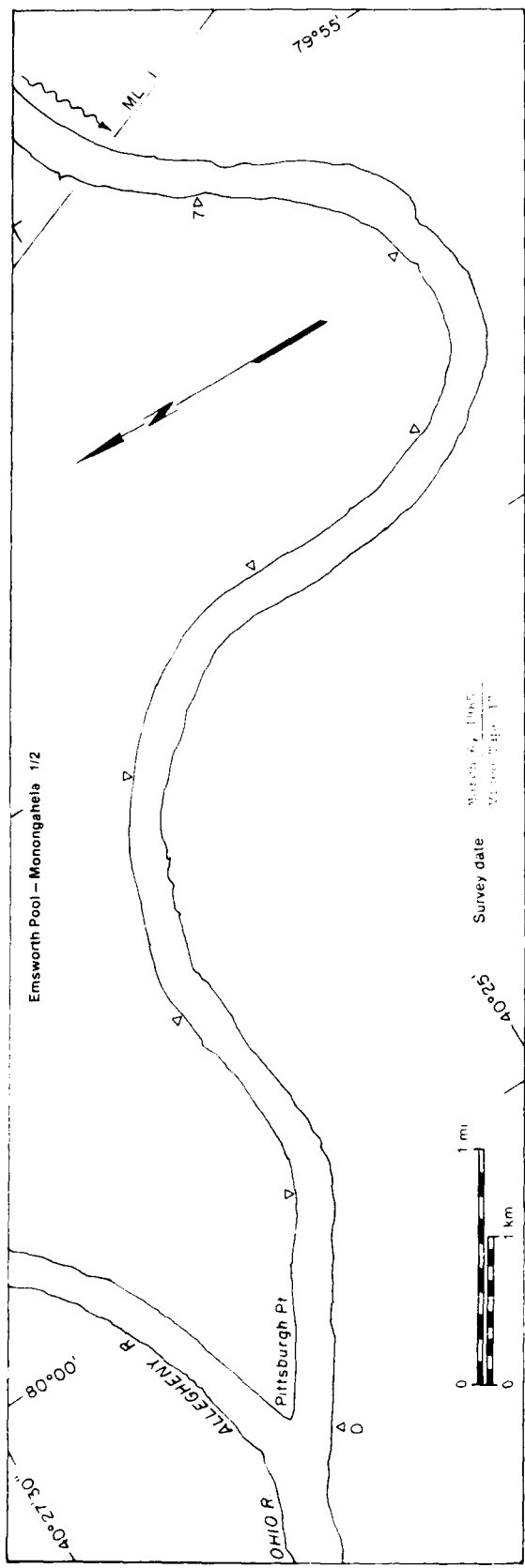
Survey date: March 14, 1985
 Station: 1000

Hannibal Pool		Surface Concept Location	
Station	Notes	Station	Notes
127	Point A	128	Point A
128	Point B	129	Point B
129	Point C	130	Point C
130	Point D	131	Point D
131	Point E	132	Point E
132	Point F	133	Point F
133	Point G	134	Point G
134	Point H	135	Point H
135	Point I	136	Point I
136	Point J	137	Point J
137	Point K	138	Point K
138	Point L	139	Point L
139	Point M	140	Point M
140	Point N	141	Point N
141	Point O	142	Point O
142	Point P	143	Point P
143	Point Q	144	Point Q
144	Point R	145	Point R
145	Point S	146	Point S
146	Point T	147	Point T
147	Point U	148	Point U
148	Point V	149	Point V
149	Point W	150	Point W
150	Point X	151	Point X
151	Point Y	152	Point Y
152	Point Z	153	Point Z

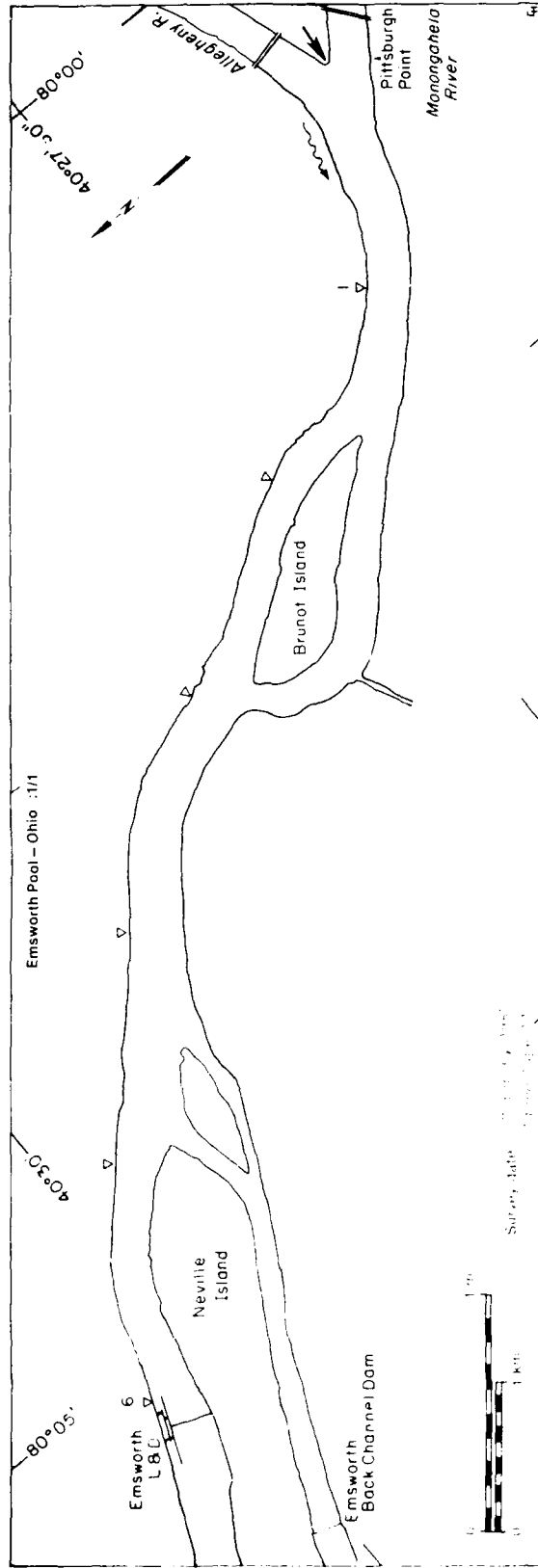
This map shows the confluence of the Ohio River and Monongahela River. Key features include:

- Emsworth Pool - Allegheny**: Located at the top left, with a depth of 111.
- Ohio R**: The main river flowing from the top left towards the bottom right.
- Monongahela R**: The river flowing from the bottom right towards the top right.
- Islands**:
 - Her's Isl**: A small island in the Ohio River.
 - Sixmile Isl**: A larger island near the top right.
- Lock & Dam #2**: Located near Sixmile Isl.
- Pittsburgh Point**: A point on the Monongahela River.
- Survey Data**:
 - 40° 27' 30"**: A survey point near Pittsburgh Point.
 - 40° 08'**: A survey point near Her's Isl.
 - 40° 30'**: A survey point near Sixmile Isl.
 - 79° 55'**: A survey point at the top left.
- Scale**: A scale bar indicating 0 to 1 mile.
- Survey date**: 1900.

[illegible]



6 March 1985

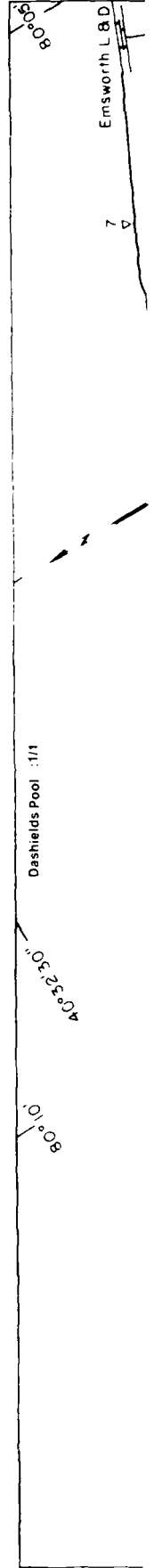


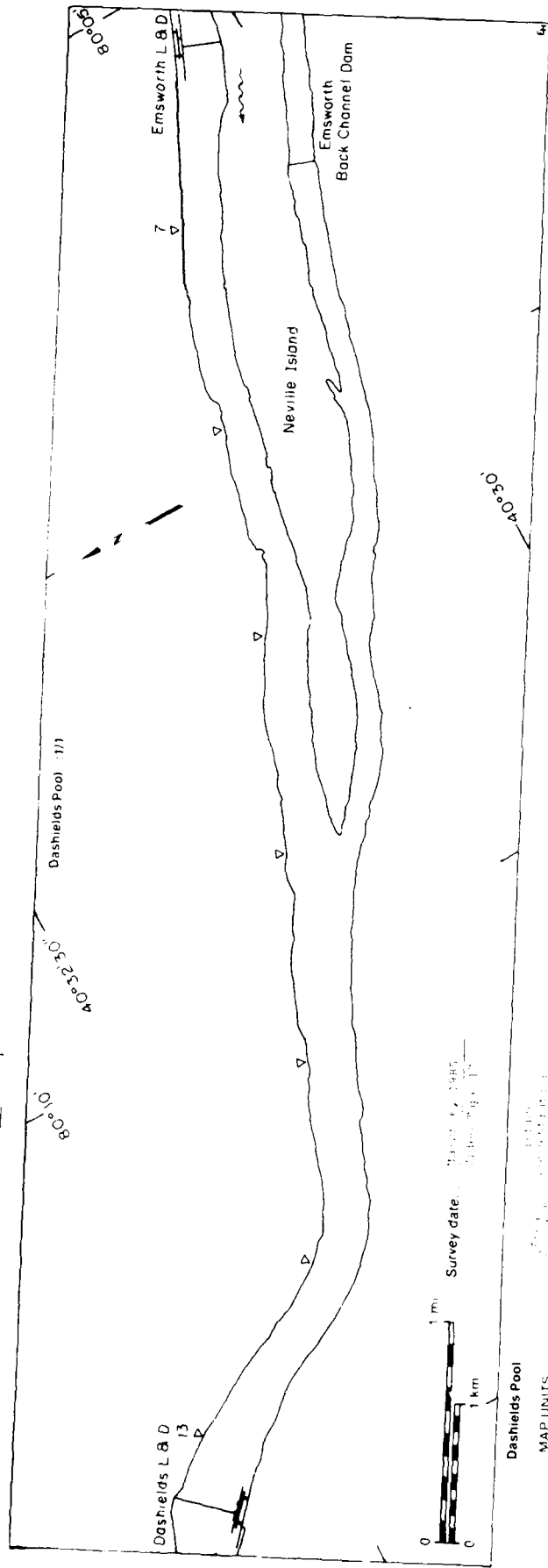
Emsworth Pool - Ohio

MAP UNITS

	Solid black
	Solid black
	Solid black with cross-hatching
	Diagonal hatching
	Horizontal hatching
	Vertical hatching
	Stippled

4.1.1	NA
4.1.2	NA
4.1.3	NA
4.1.4	NA
4.1.5	NA
4.1.6	NA
4.1.7	NA





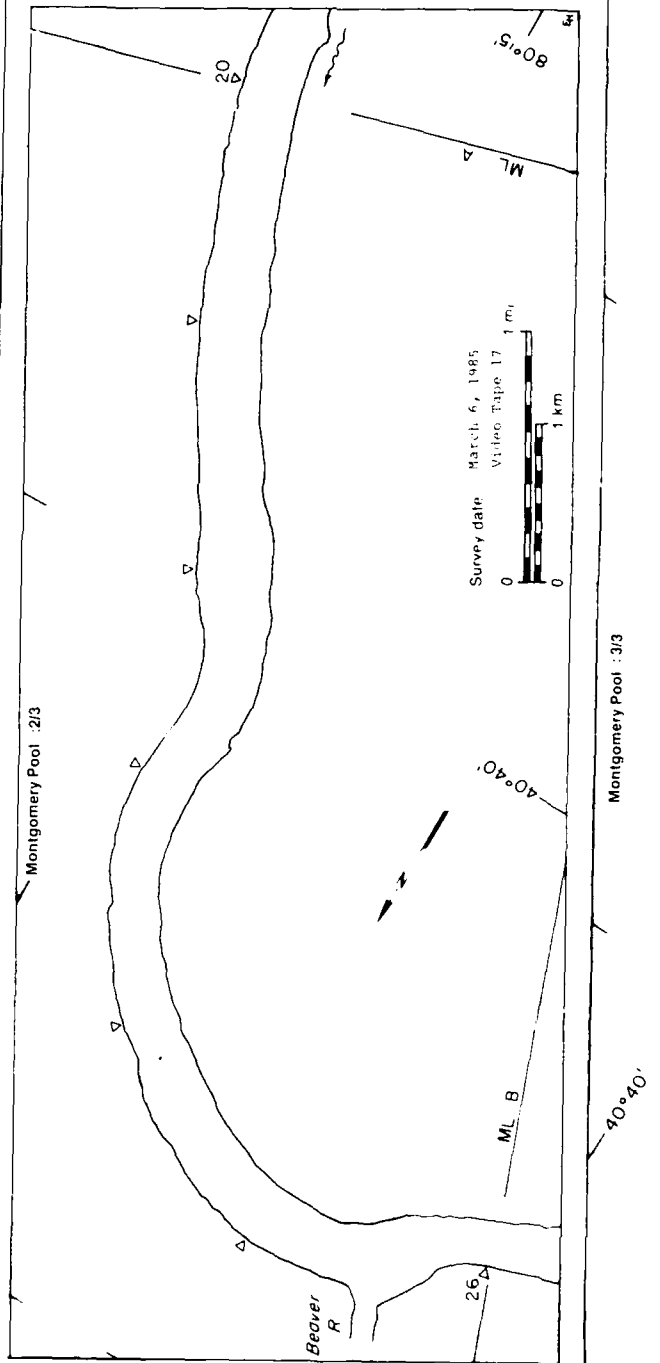
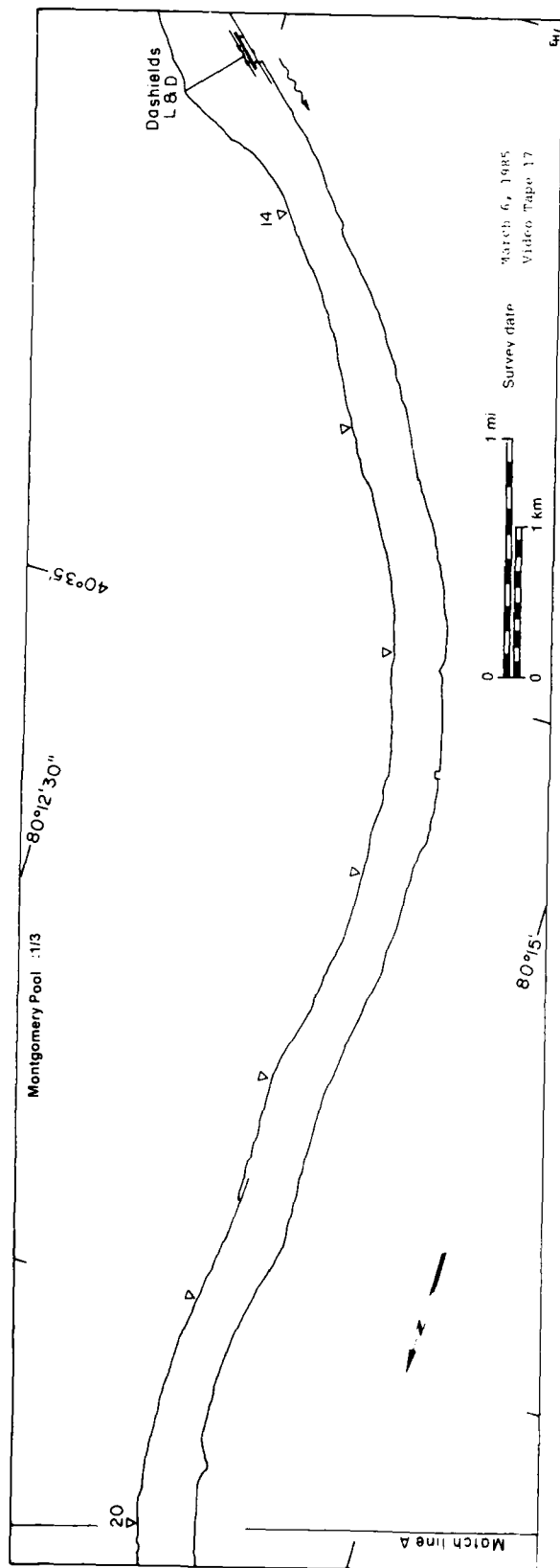
Dashiels Pool

MAP UNITS

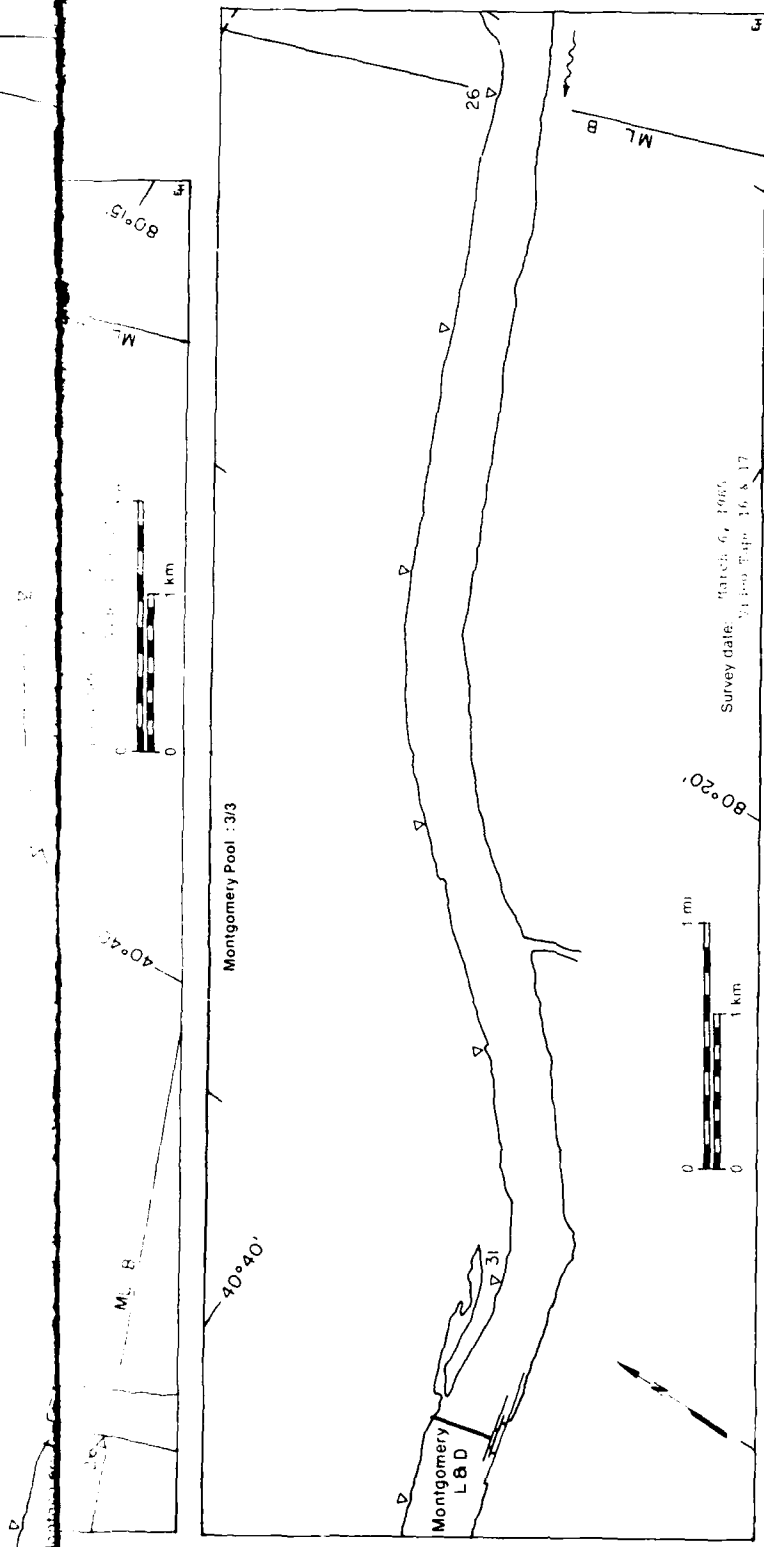


NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA
NA	NA

6 March 1985



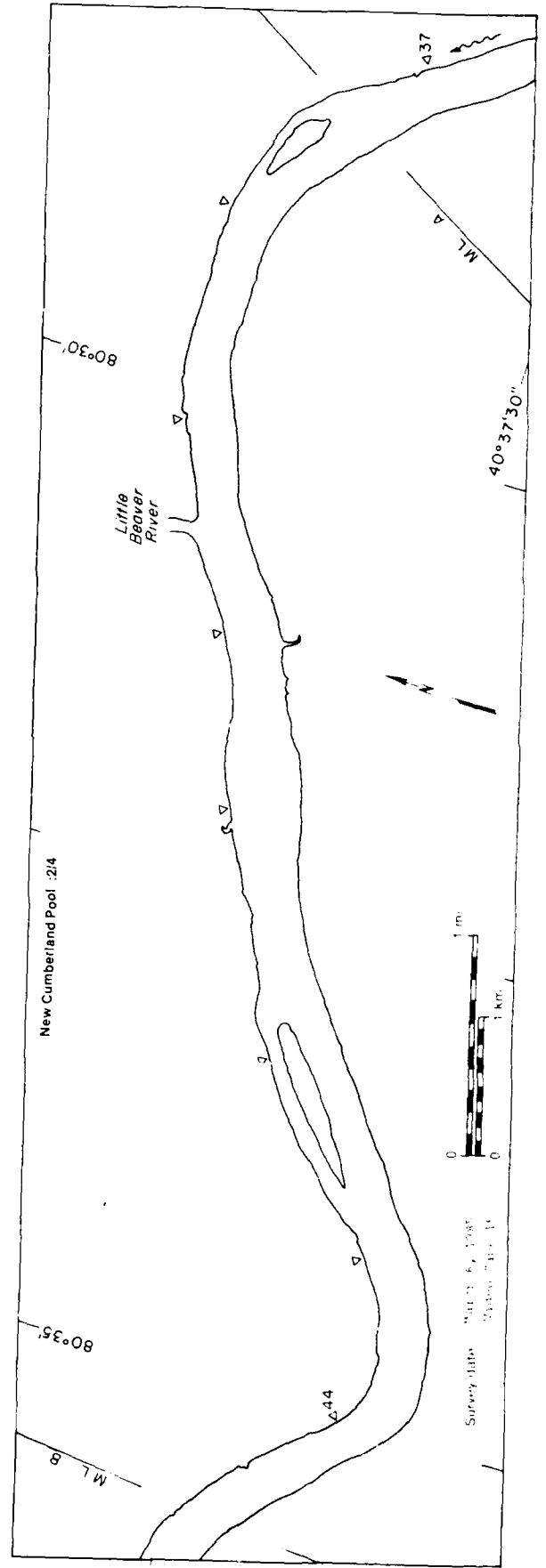
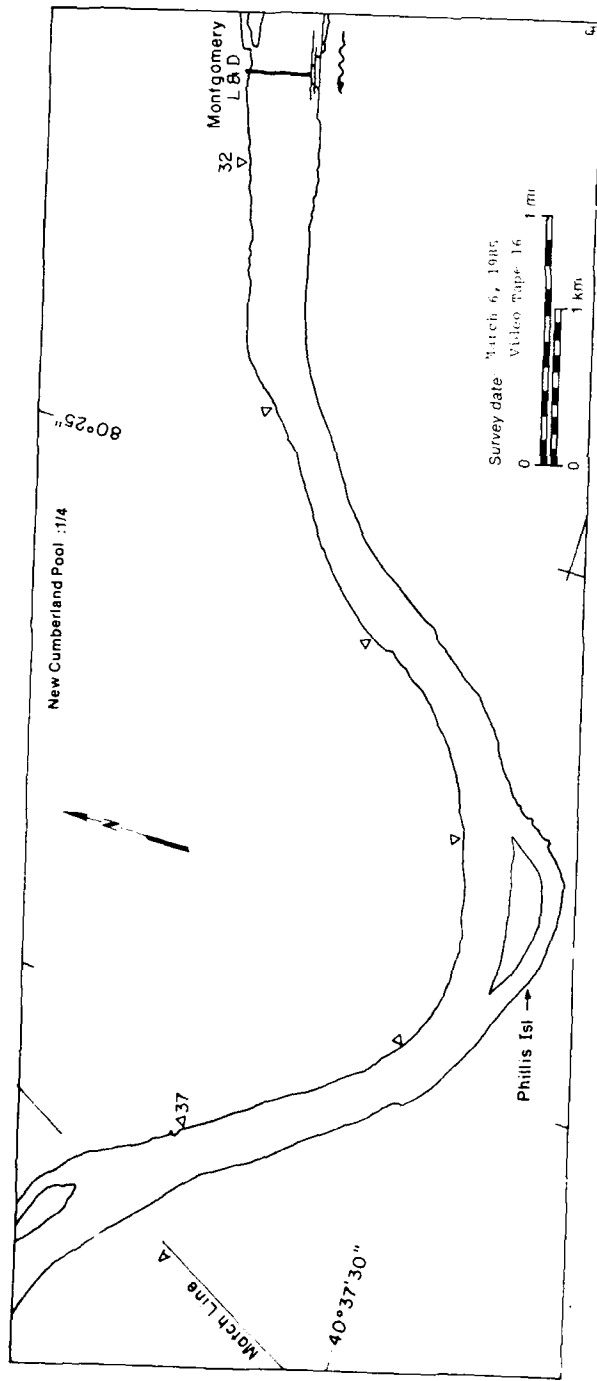
Montgomery Pool :3/3

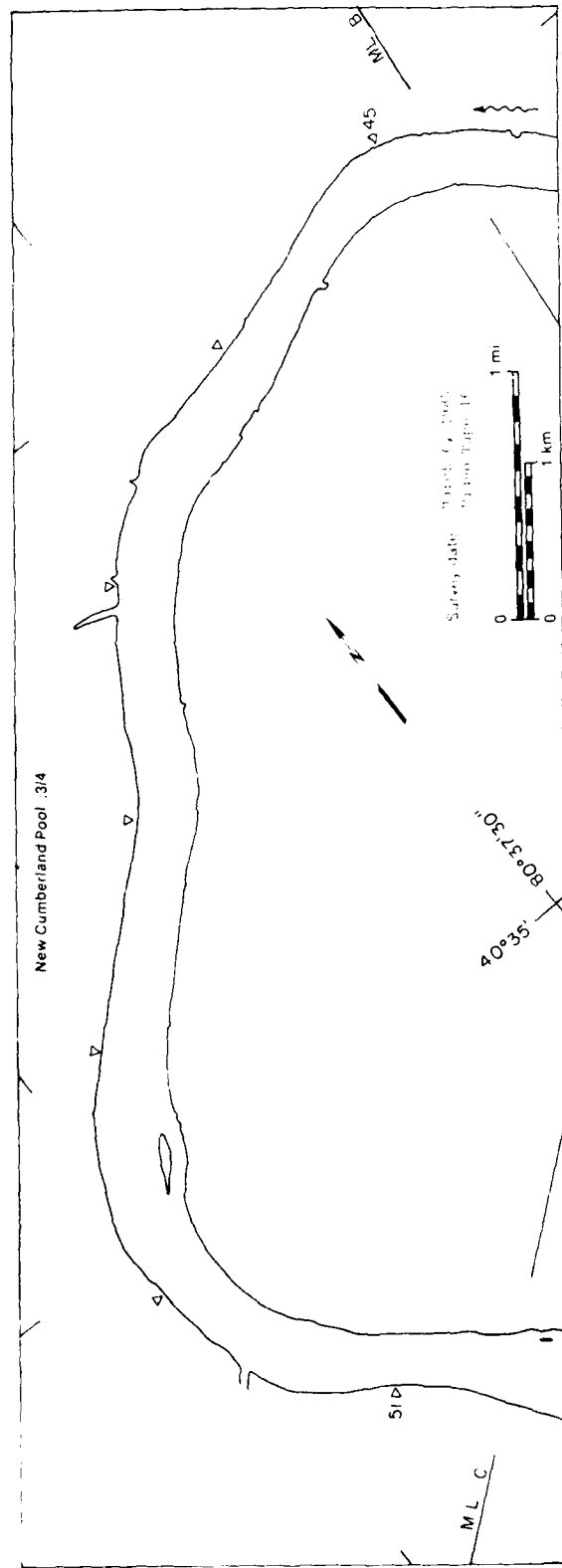
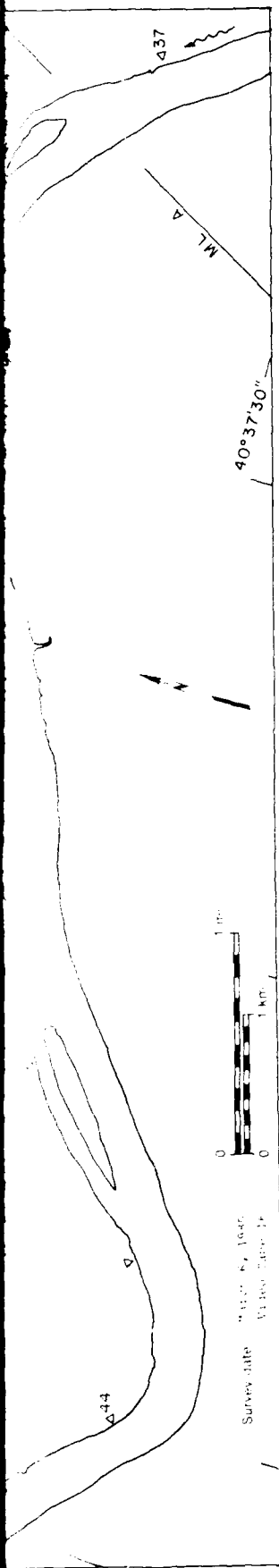


Montgomery Pool

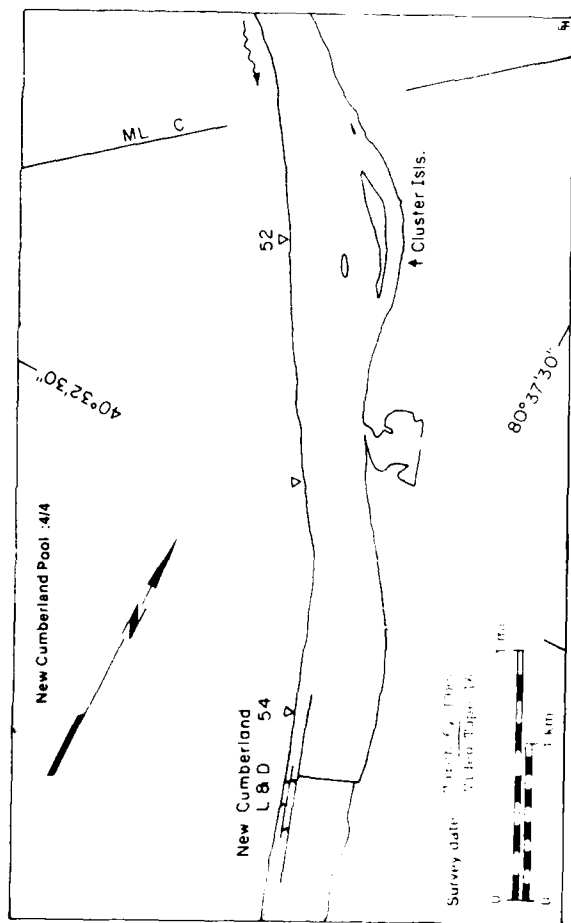
MAP UNITS	Area $(m^2 \times 10^6)$	Surface concentration (%)
Open water	11.27	NA
Solid ice cover	---	NA
Solid ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	---	---
Ice floes or frazil slush and pans	---	---
Total Area $(m^2 \times 10^6)$	11.27	

March 1985



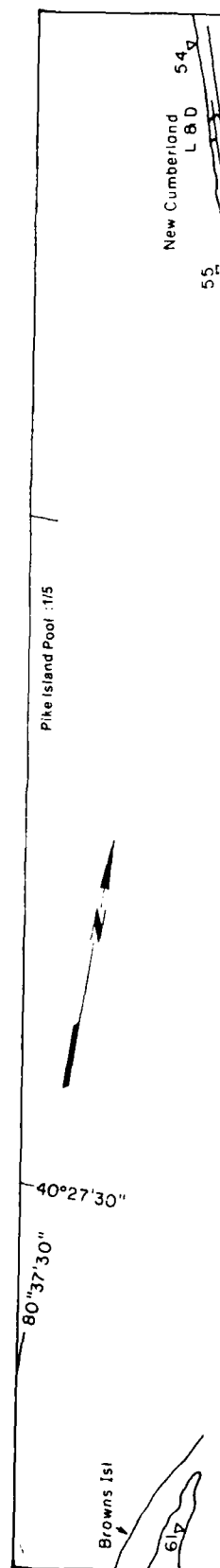


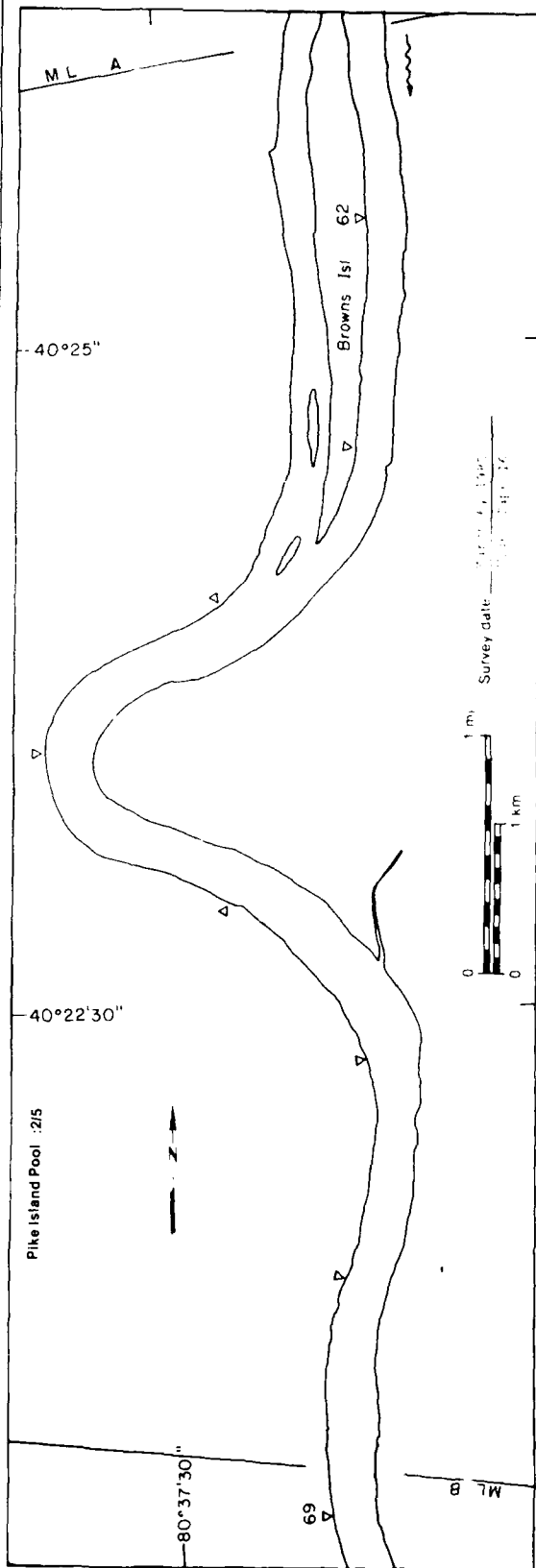
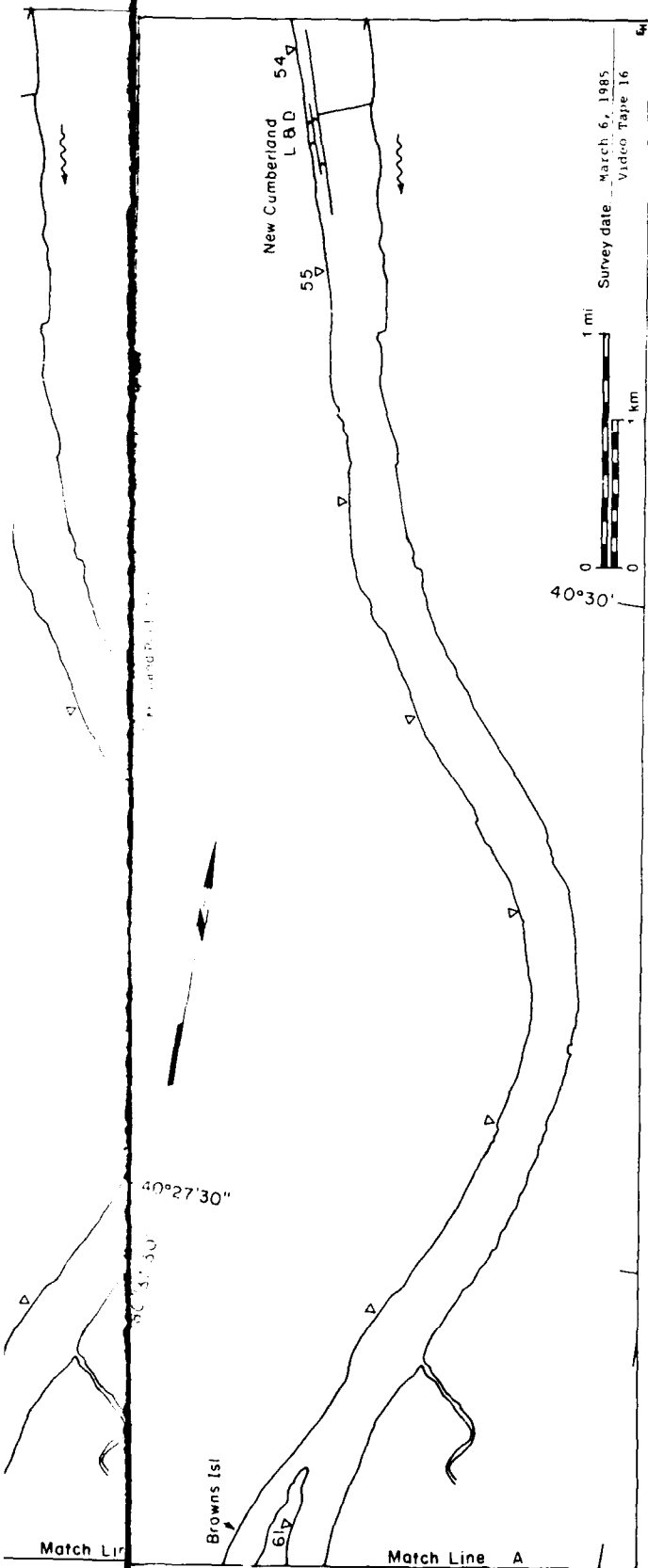
6 March 1985



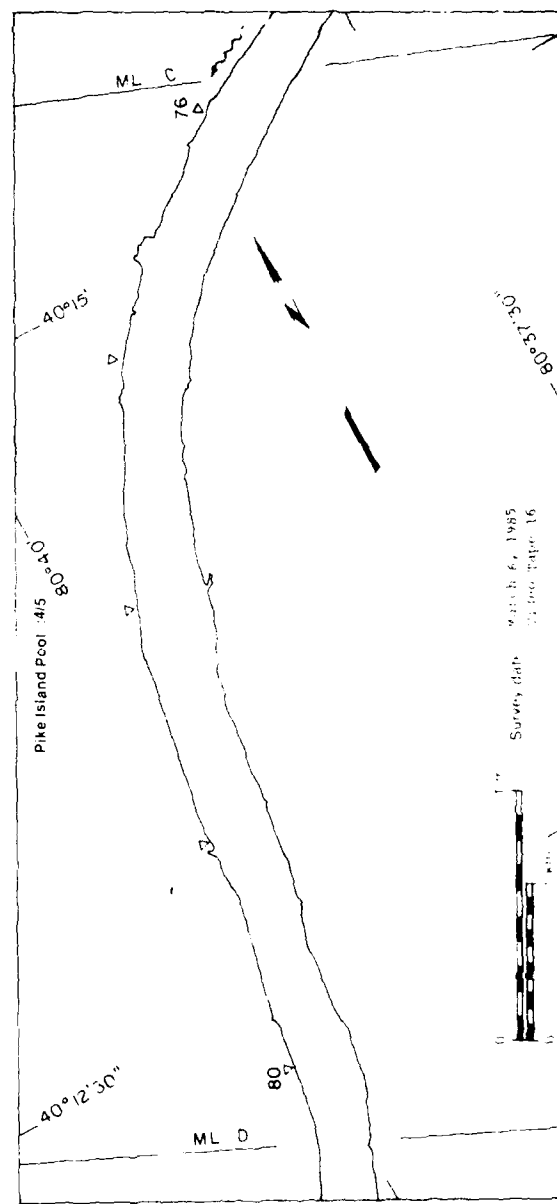
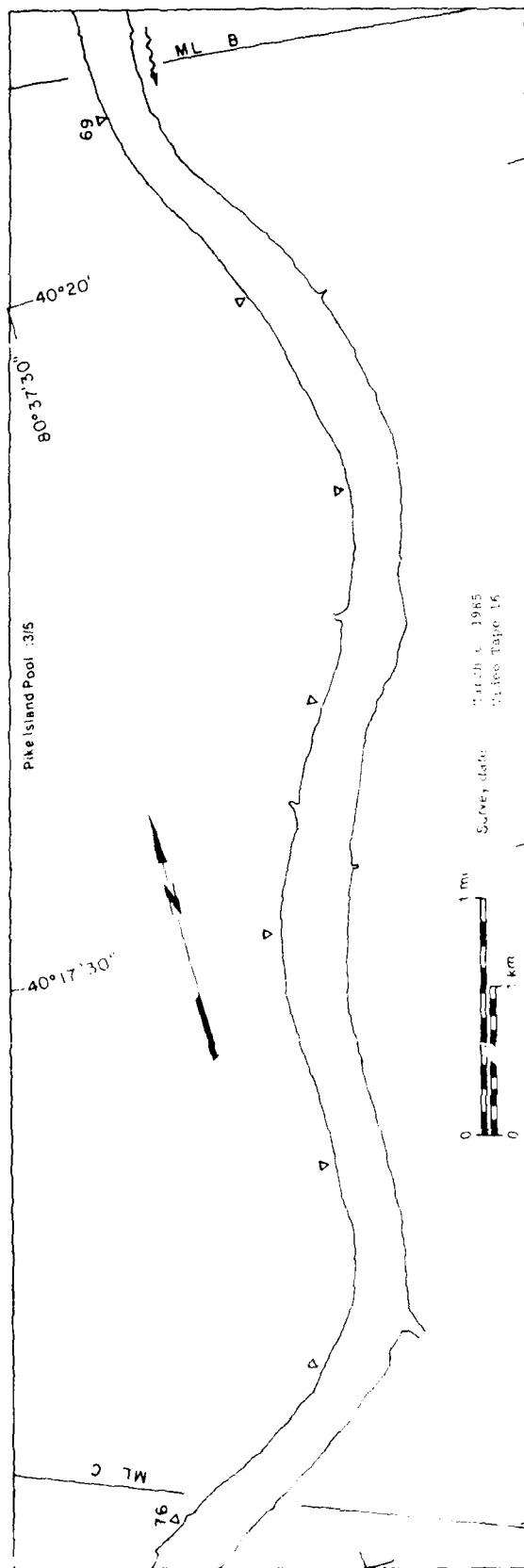
New Cumberland Pool

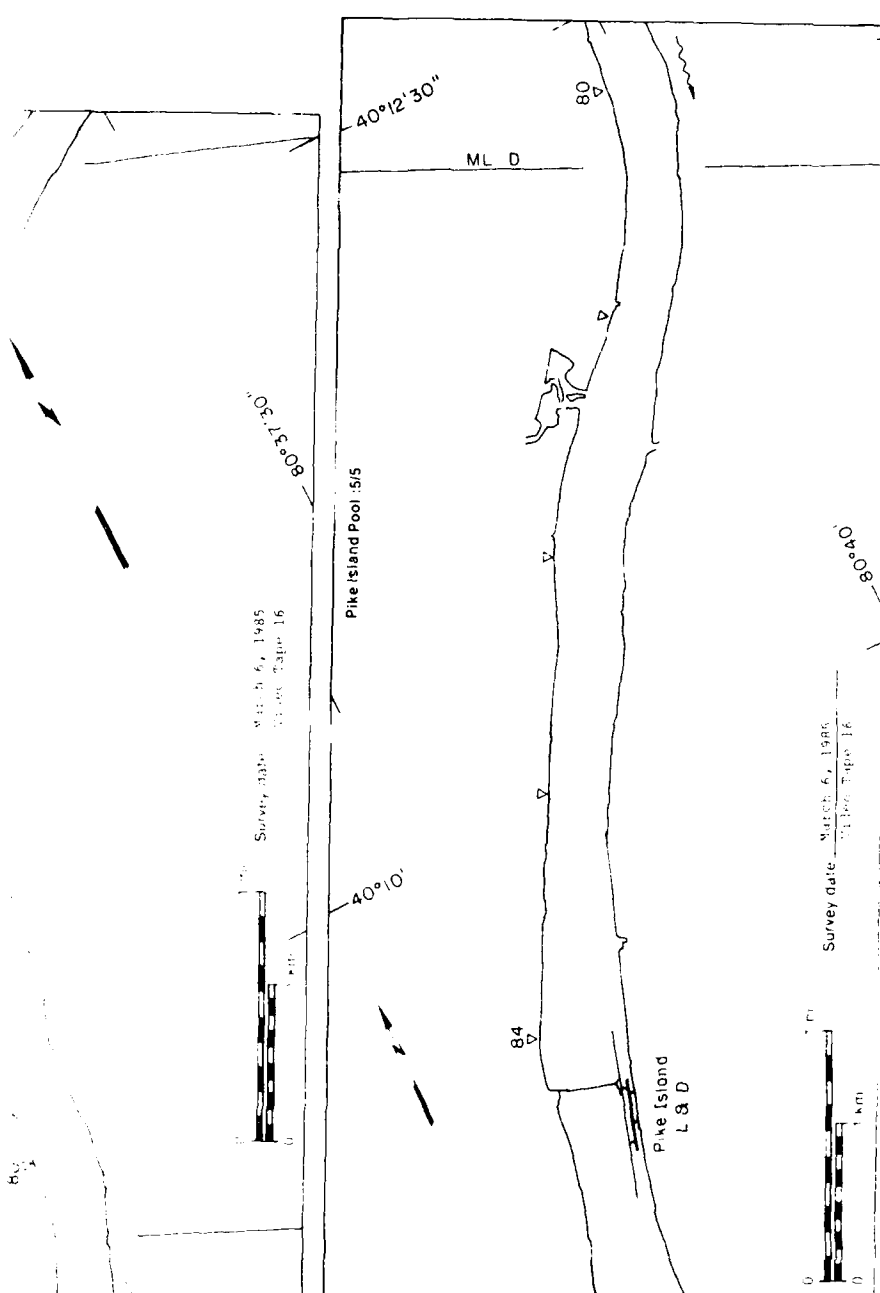
MAP UNITS		Area ($\text{m}^2 \times 10^6$)	Surface concentration (%)
	Open water	14.87	NA
	Solid ice cover	---	NA
	Solid ice cover with open water areas	---	---
	Fragmented ice cover	---	NA
	Fragmented ice cover with open water areas	---	---
	Ice flows or frazil slush and pans	---	---
Total Area ($\text{m}^2 \times 10^6$)		14.87	





6 March 1985





Pike Island Pool

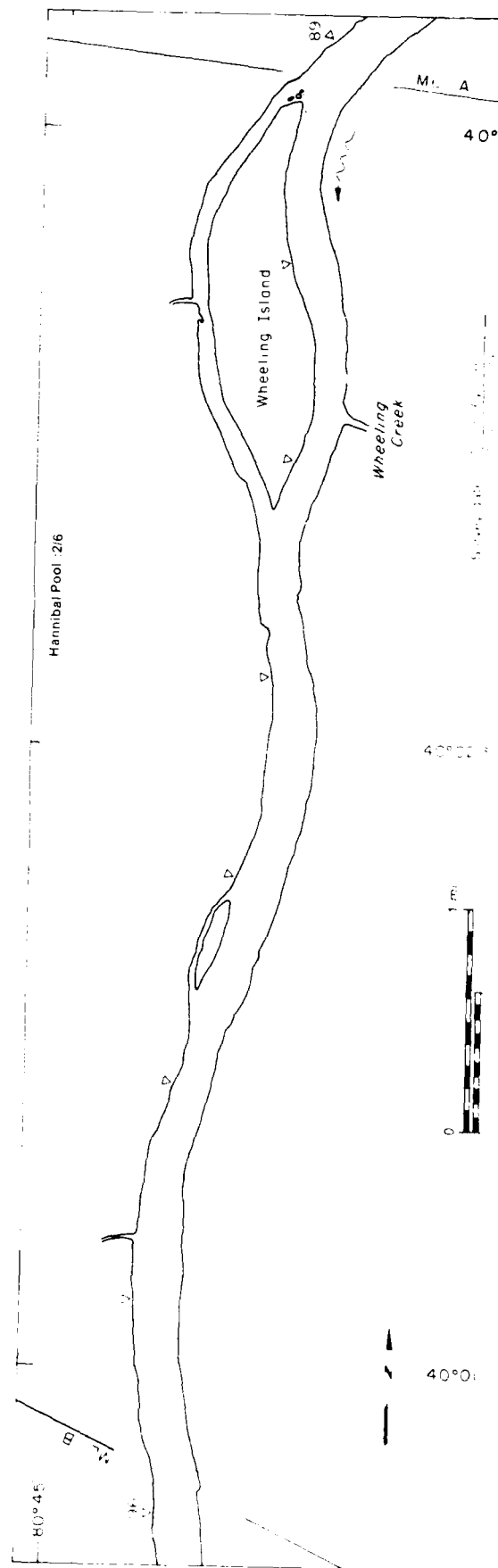
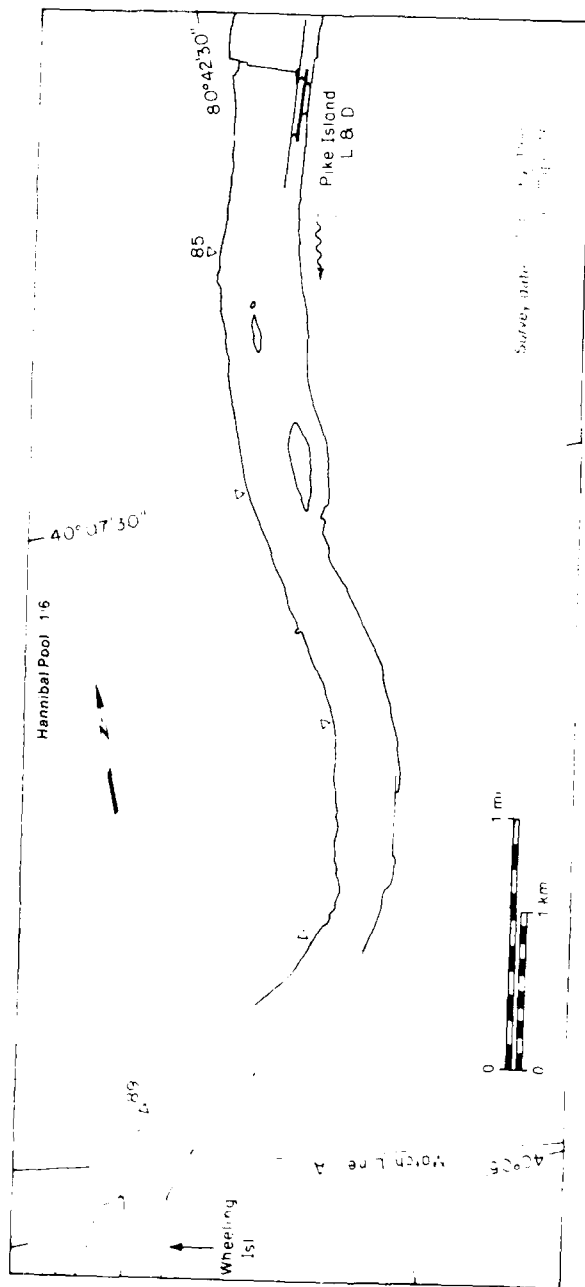
MAP UNITS

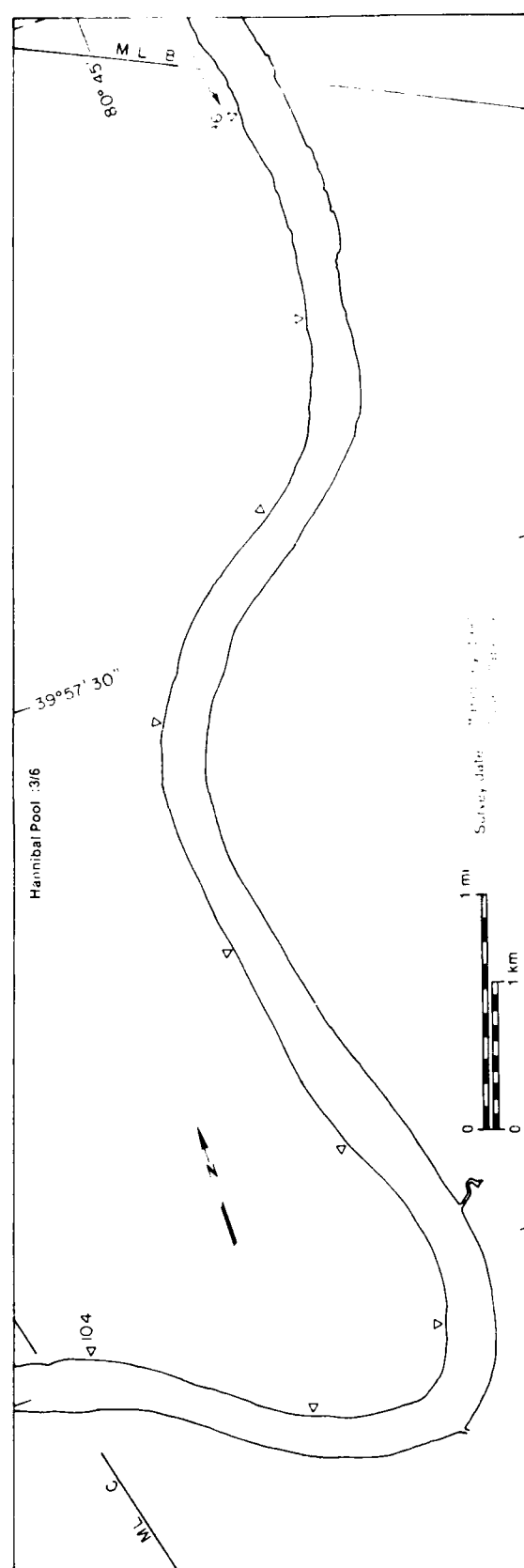
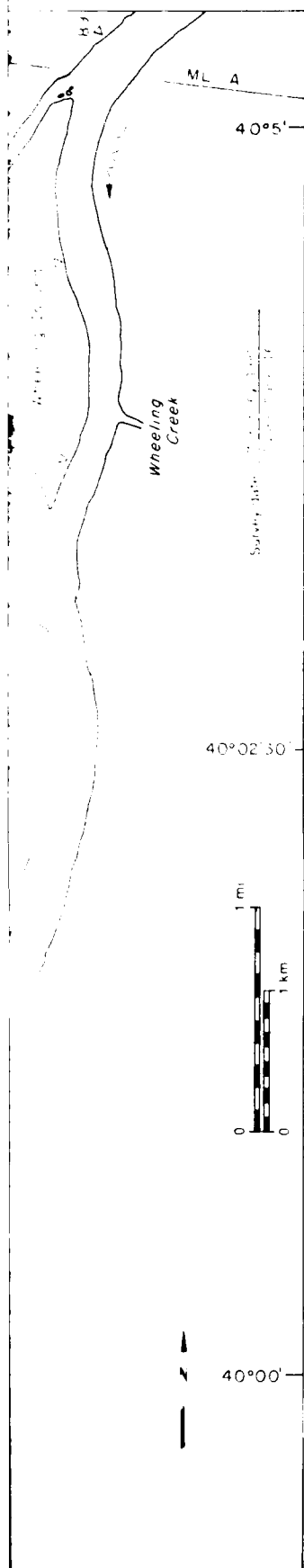
Open water	NA
Shrub	NA
Shrub (open water with open water tracks)	NA
Fragmented shrub	NA
Fragmented shrub (open water tracks)	NA
Shrub (open water tracks)	NA

Area: 1.11 km²

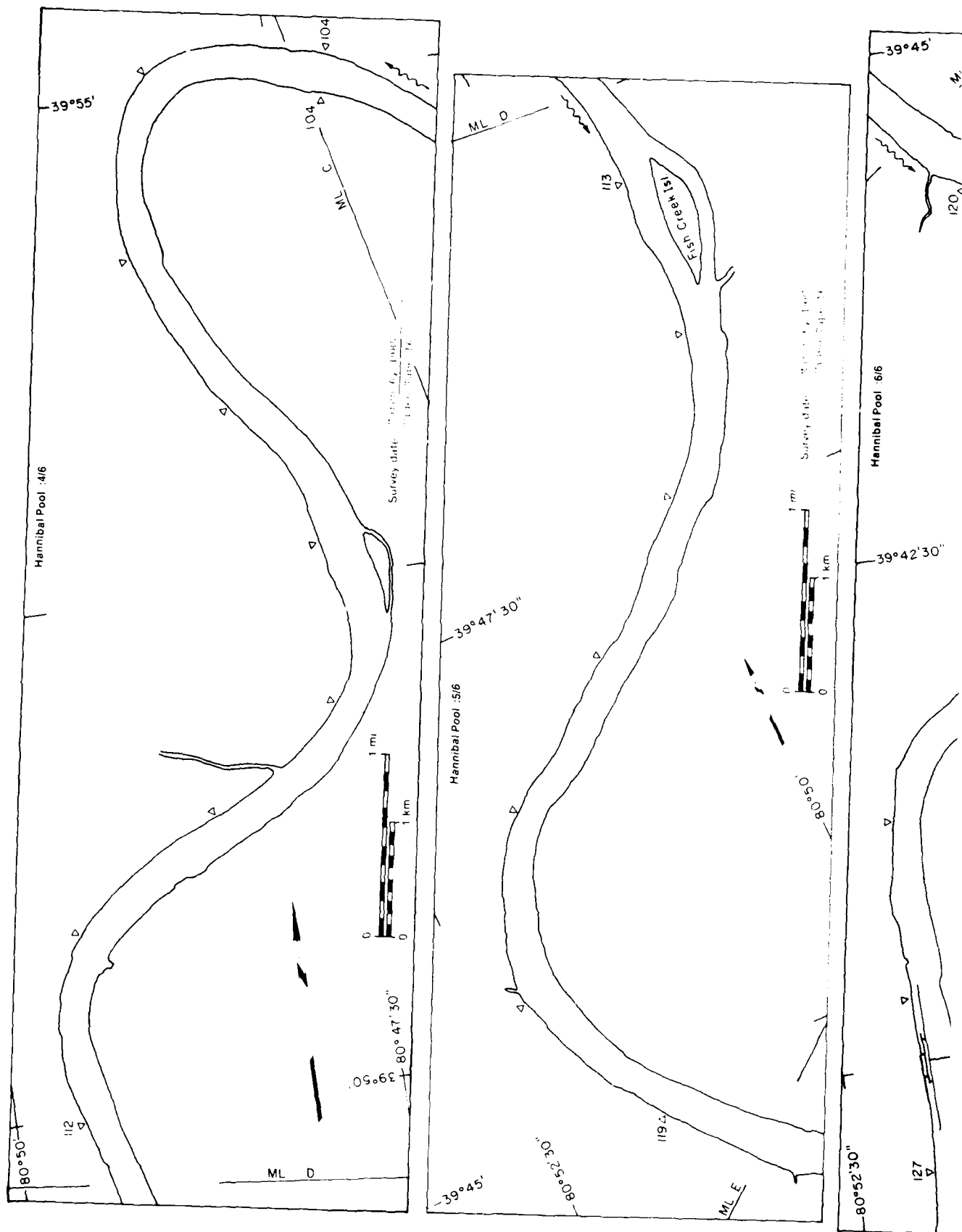
Perimeter: 1.1 km

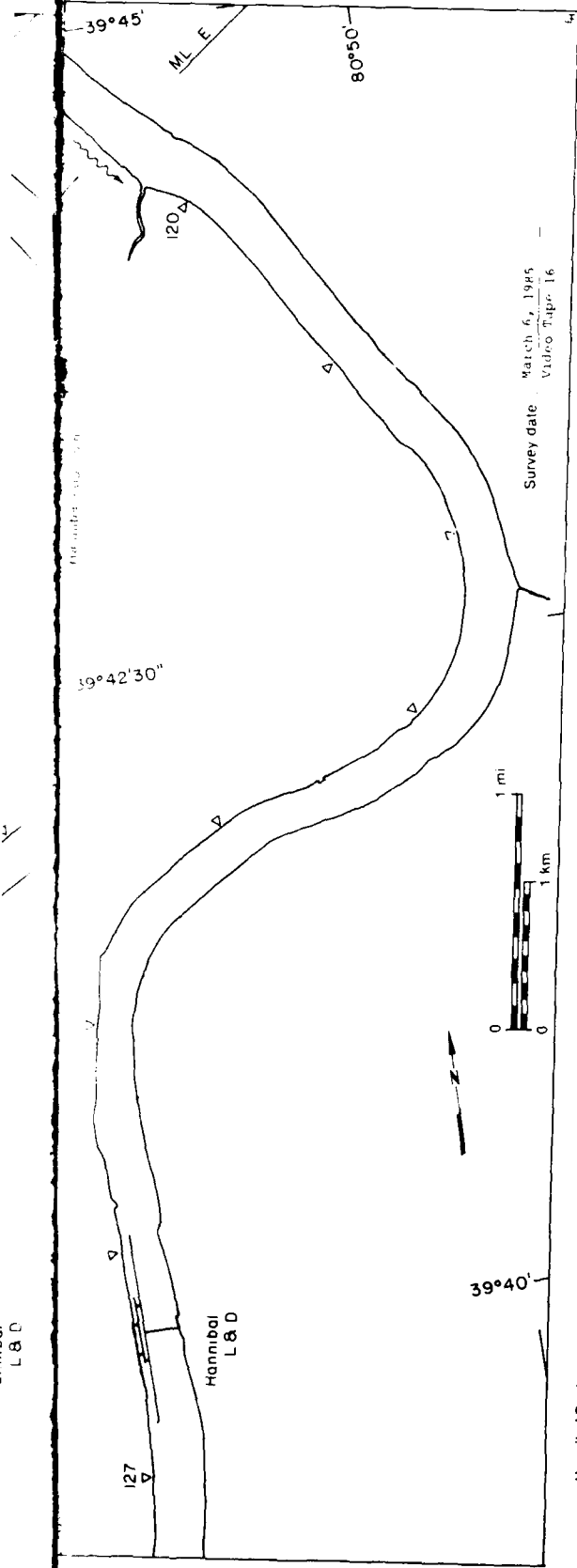
6 March 1985





6 March 1985

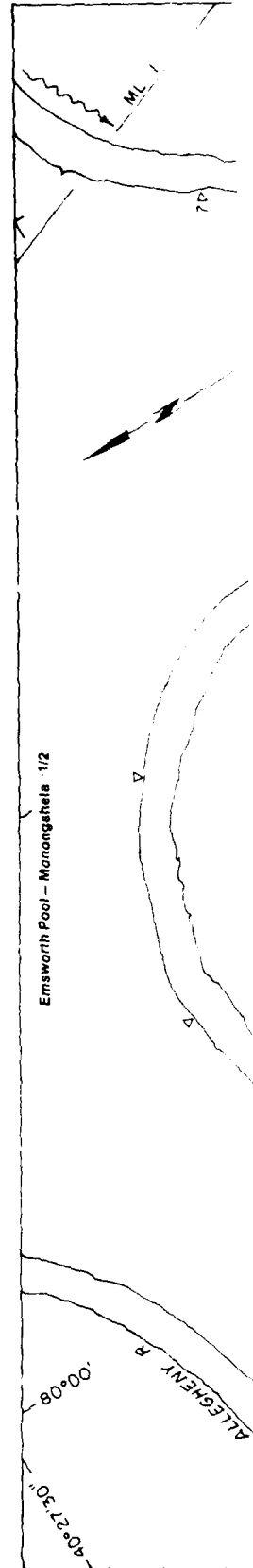
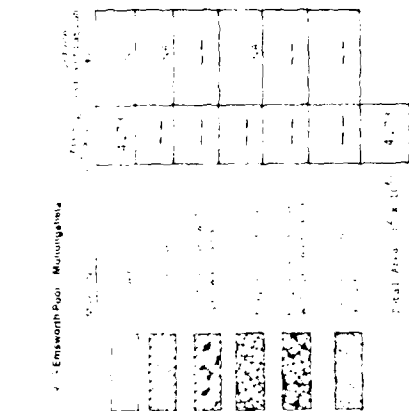
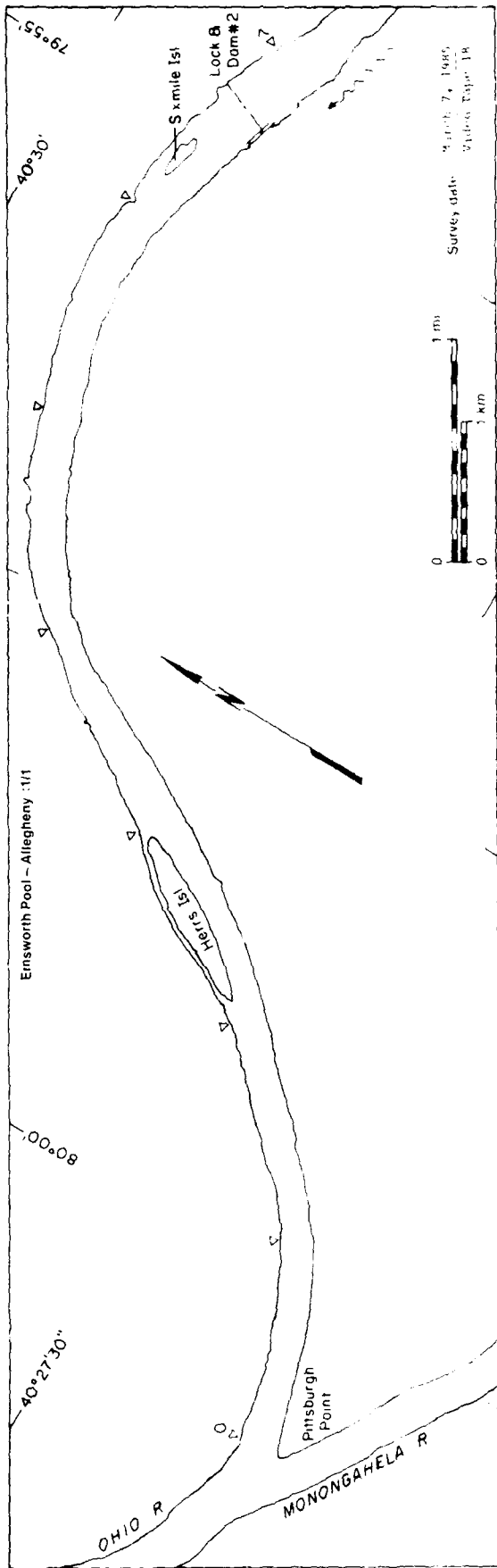


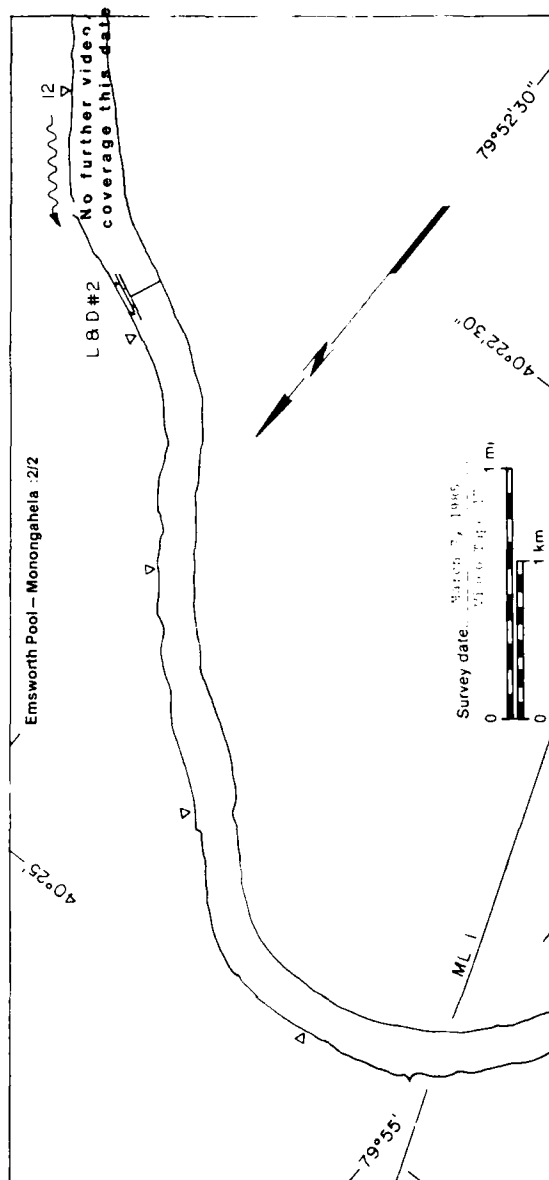
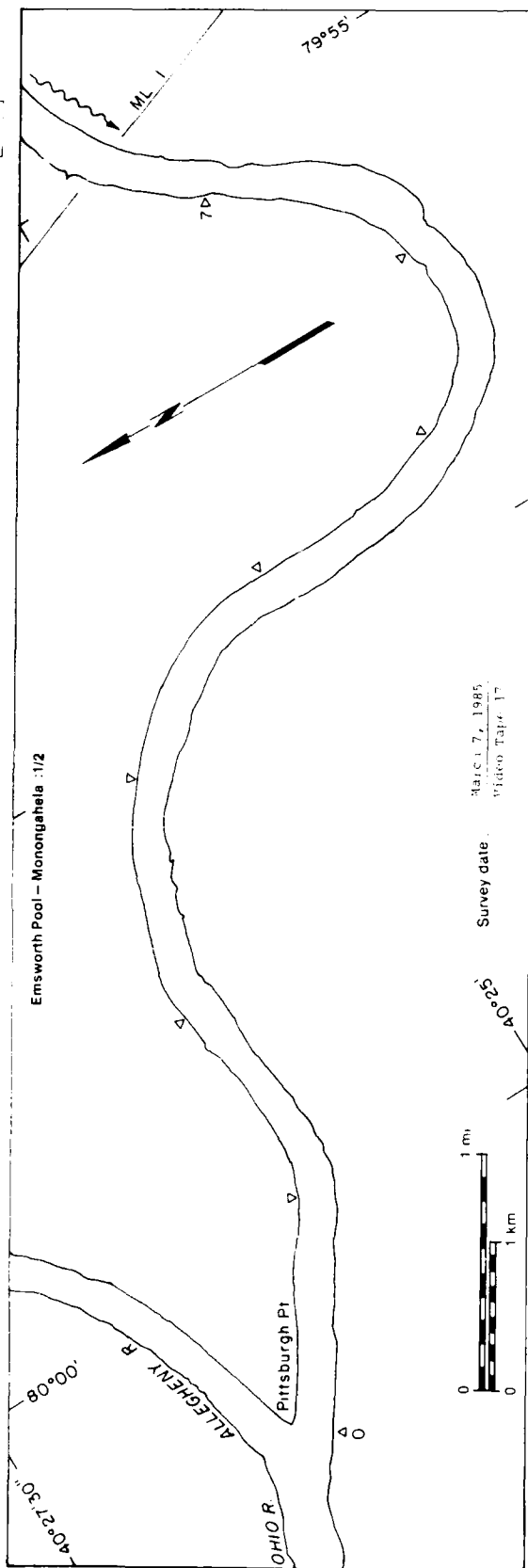


Survey date: March 6, 1985
Video Tape: 16

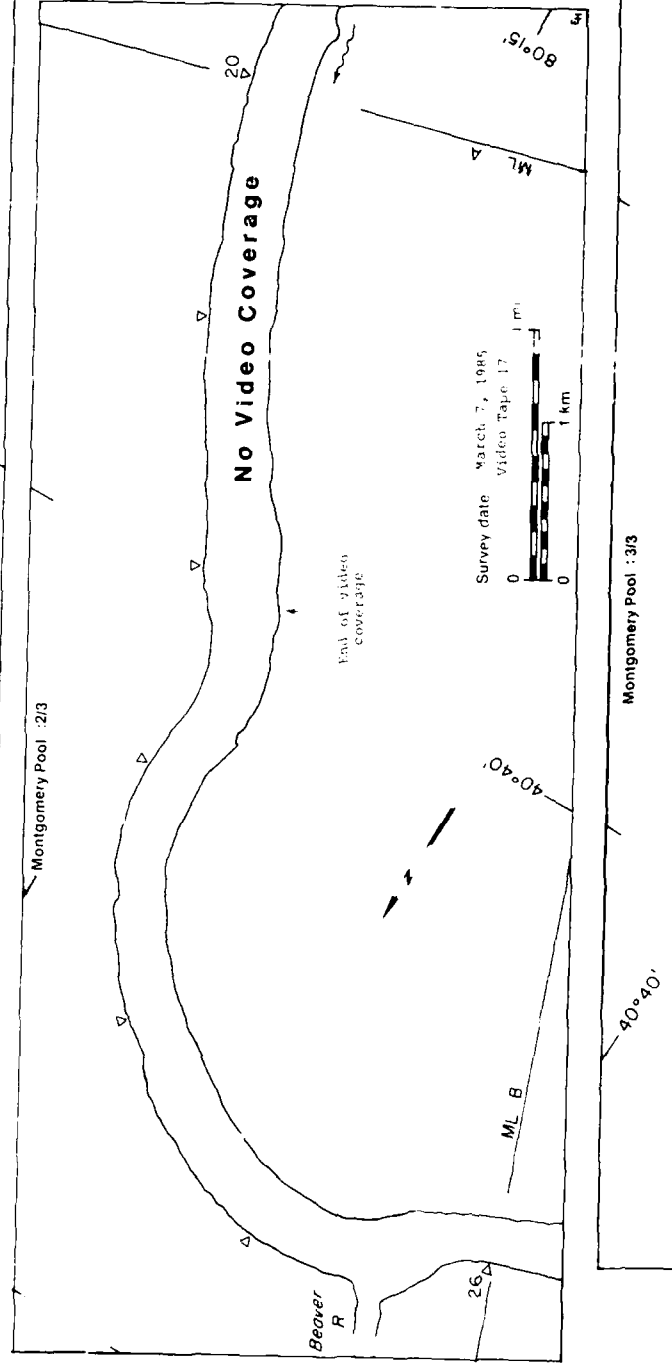
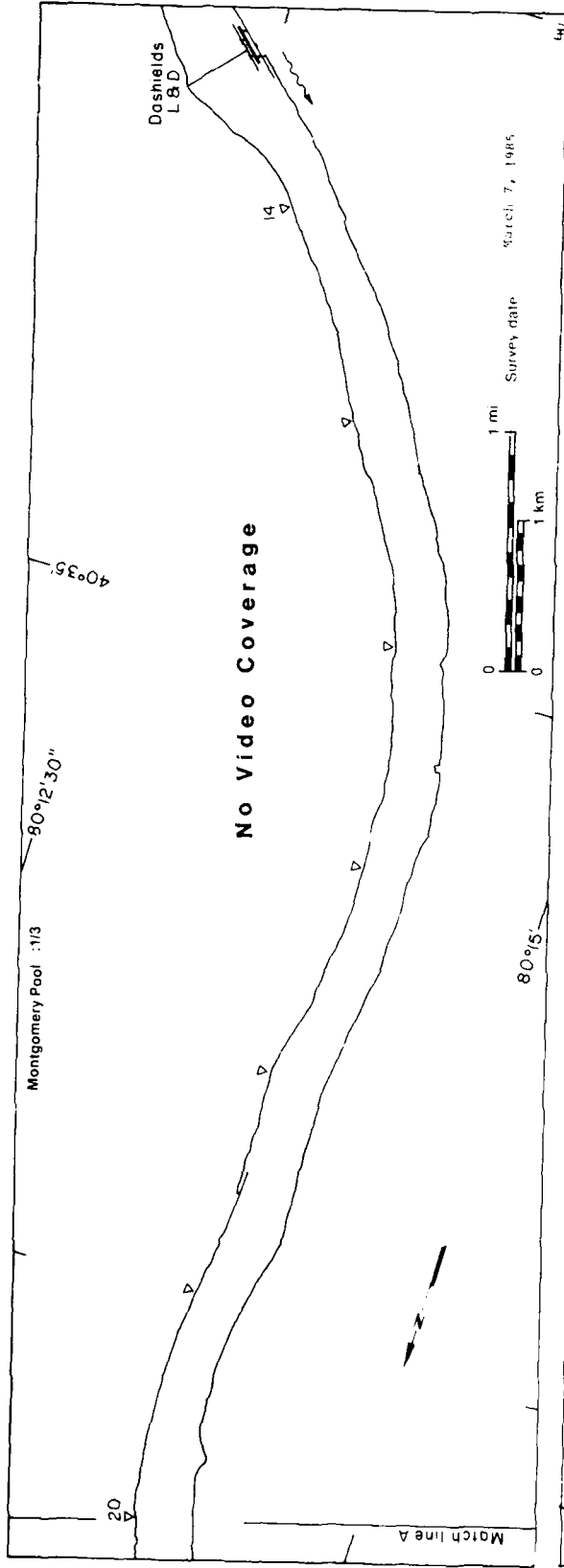
Hannibal Pool		
MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (%)
Open water	22.46	NA
Solid ice cover	—	NA
Solid ice cover with open water areas	—	—
Fragmented ice cover	—	NA
Fragmented ice cover with open water areas	—	—
Ice floes or "churn" and pans	—	—
Total Area (m ² x 10 ⁶)	22.46	

7 March 1985

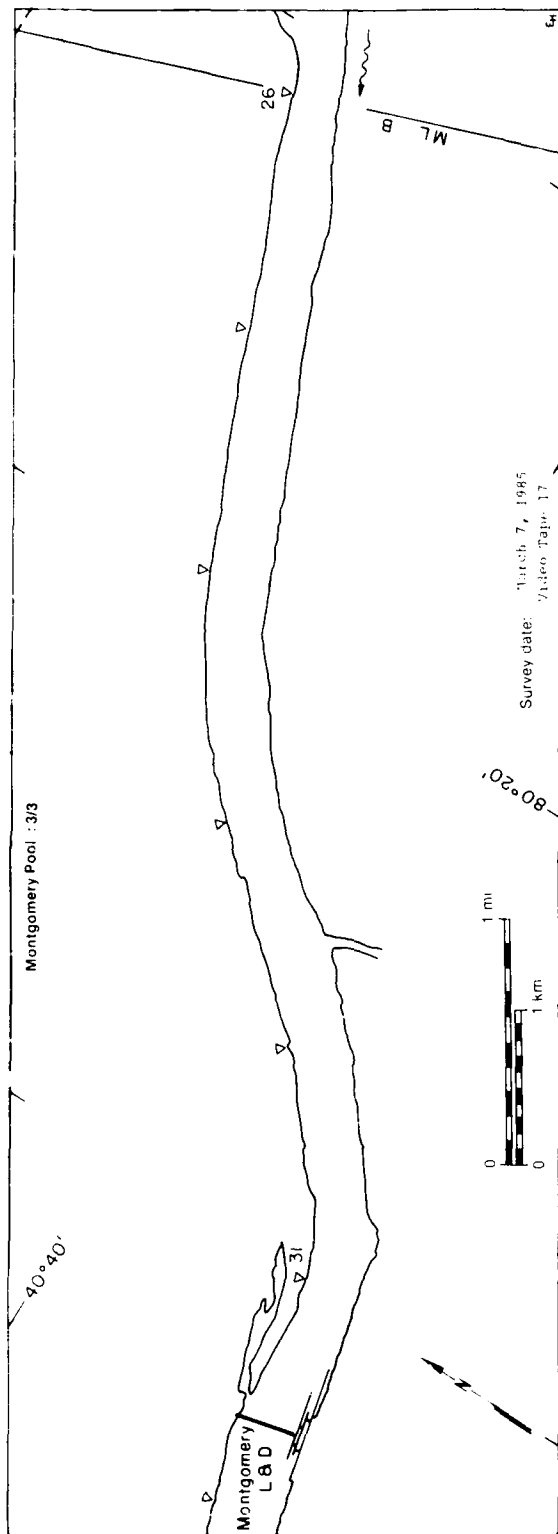




7 March 1985

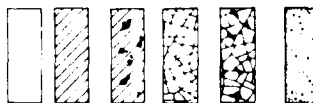


Montgomery Pool : 3/3



Montgomery Pool

MAP UNITS



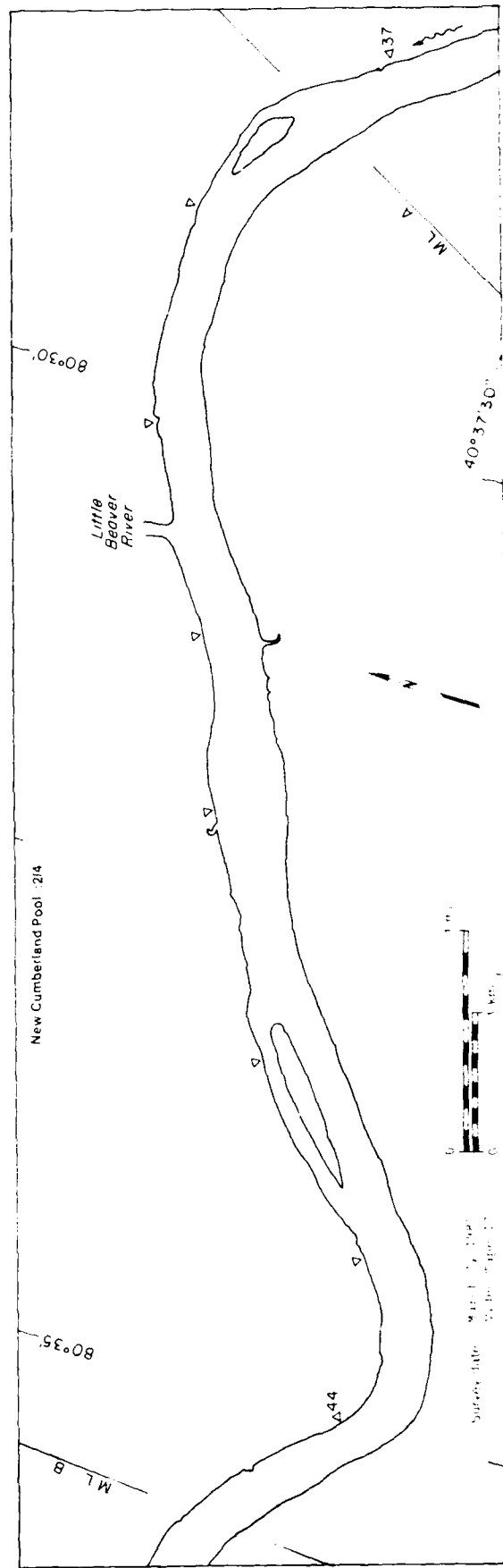
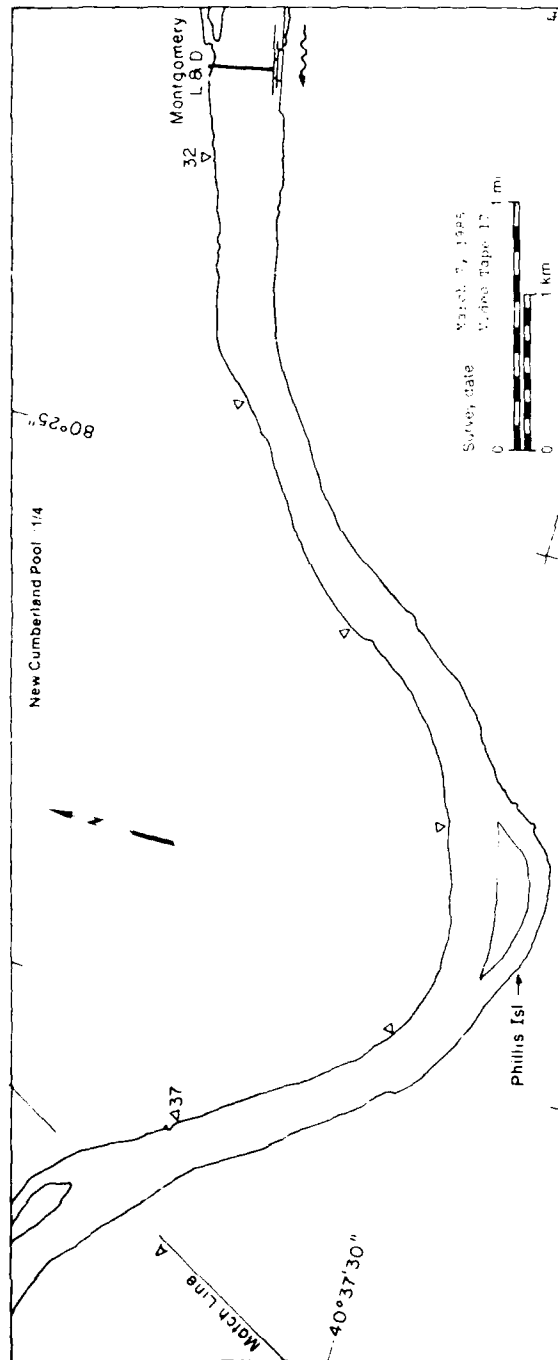
Surface concentration (%)

5.00	NA
---	NA
---	---
---	NA
---	---
---	---
---	---
11.27*	

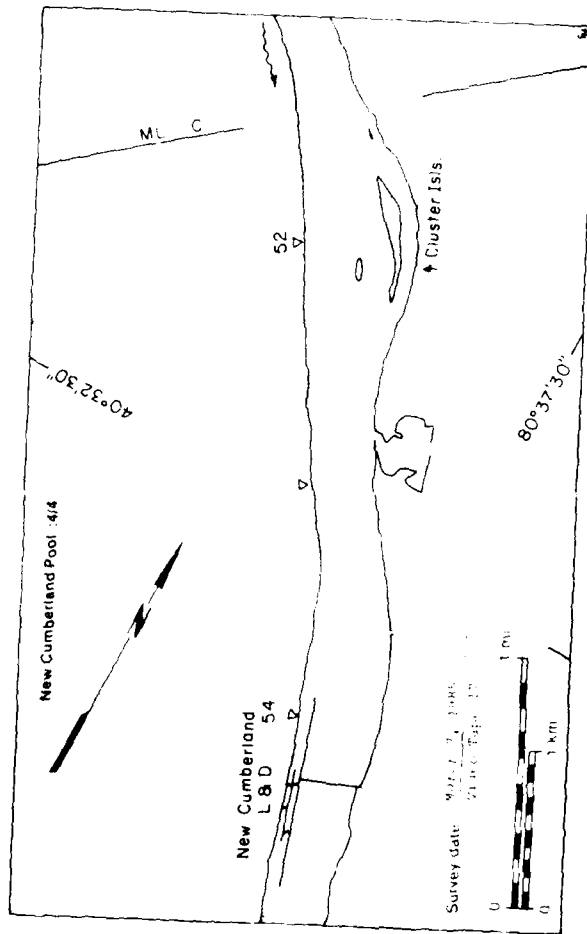
* Included 5.28% of video coverage

Total Area (x 10⁶)

7 March 1985

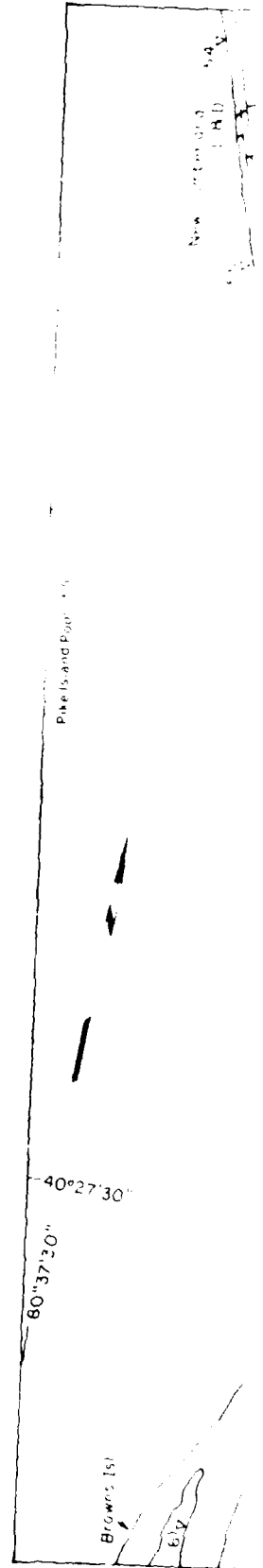


7 March 1985

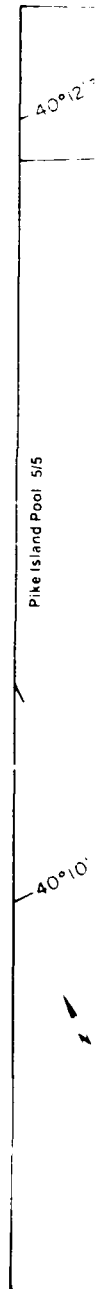
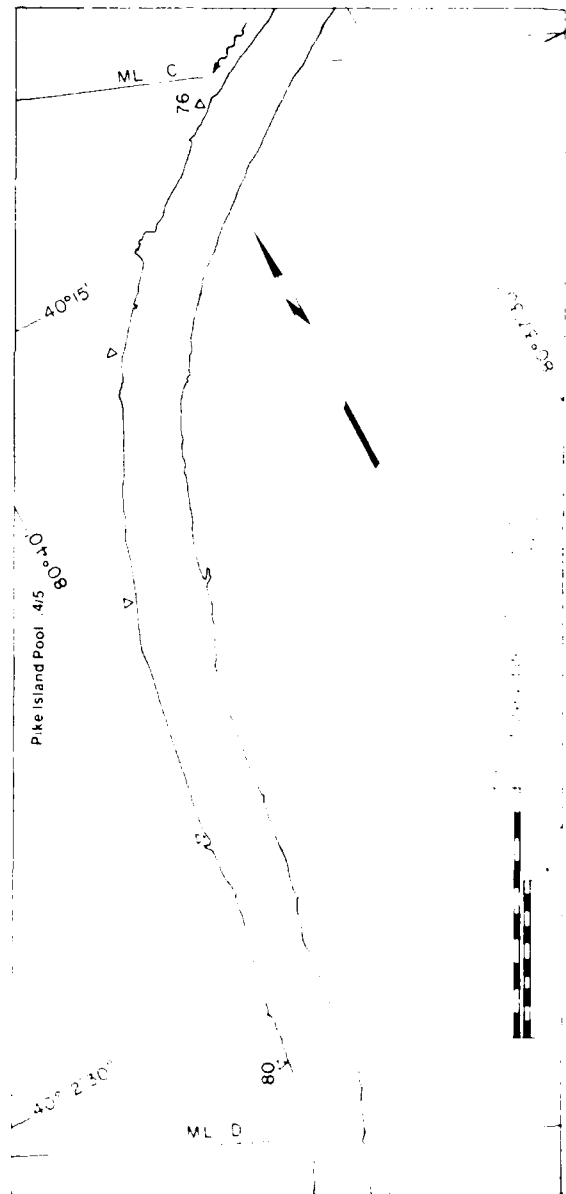
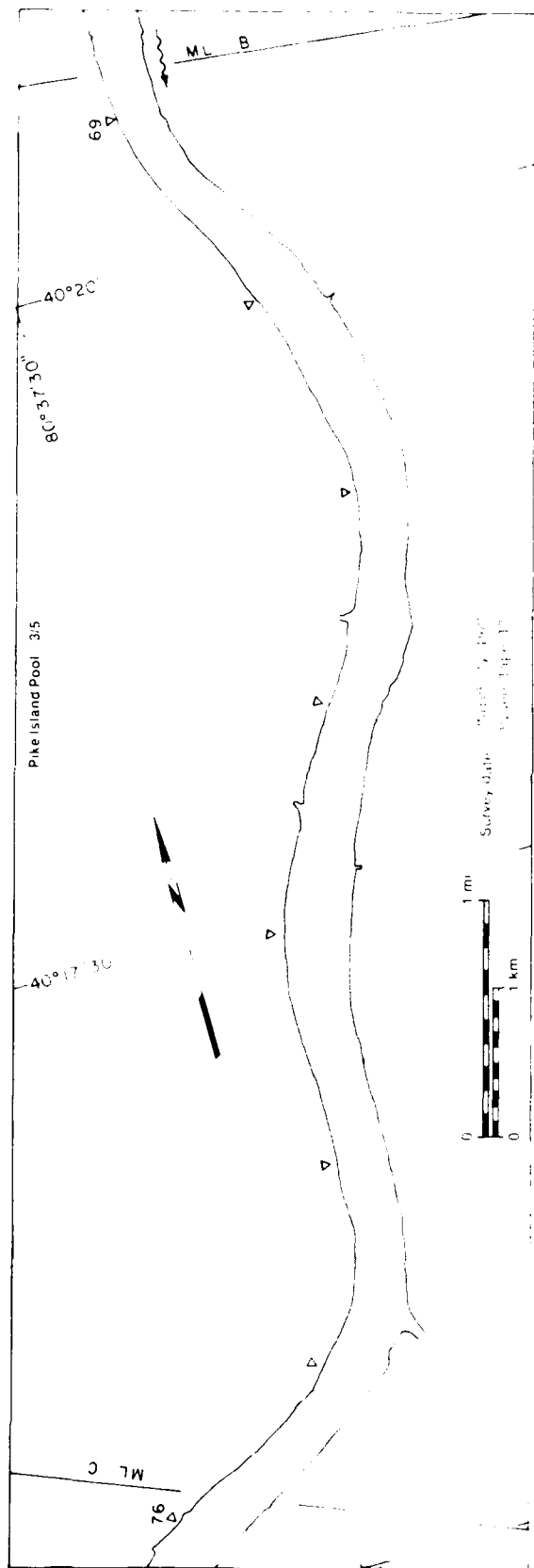


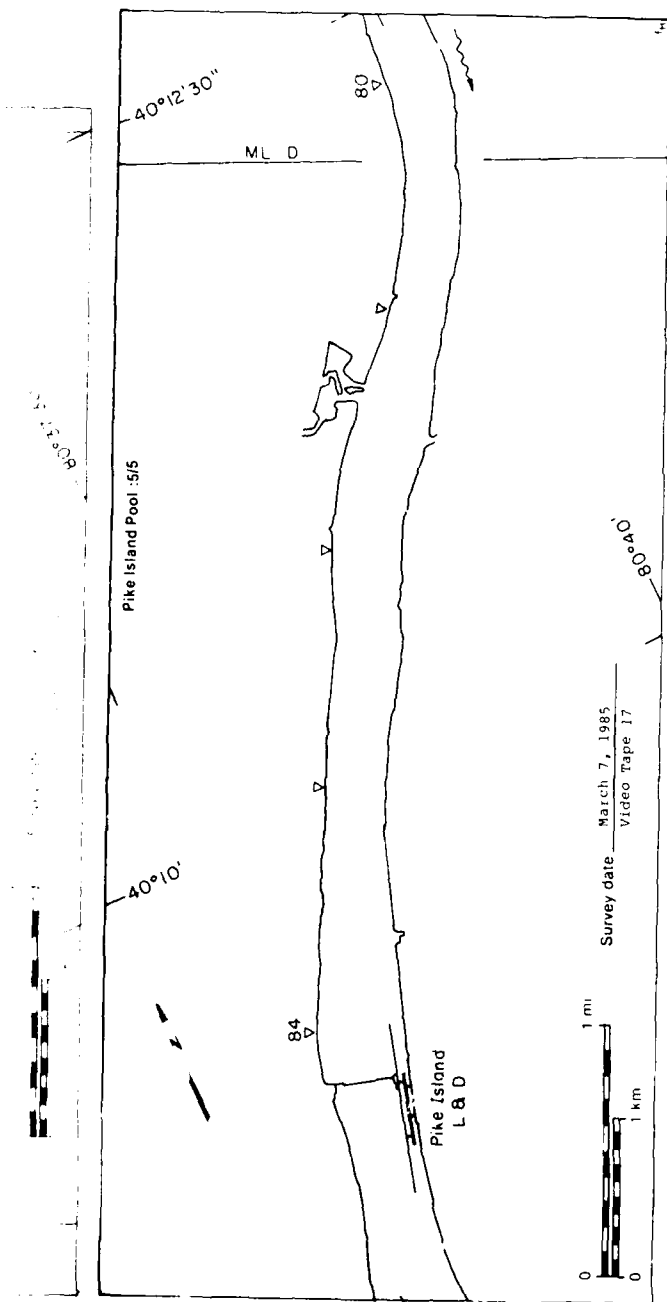
New Cumberland Pool

MAP UNITS	Surface Concentration (x 10 ⁶)	Surface Concentration (x 10 ⁶)
Open water	14.8	NA
Solid ice cover	---	NA
Solid ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	---	---
Ice floes or brash slush and pans	---	---
Total Area (x 10 ⁶)	14.8	



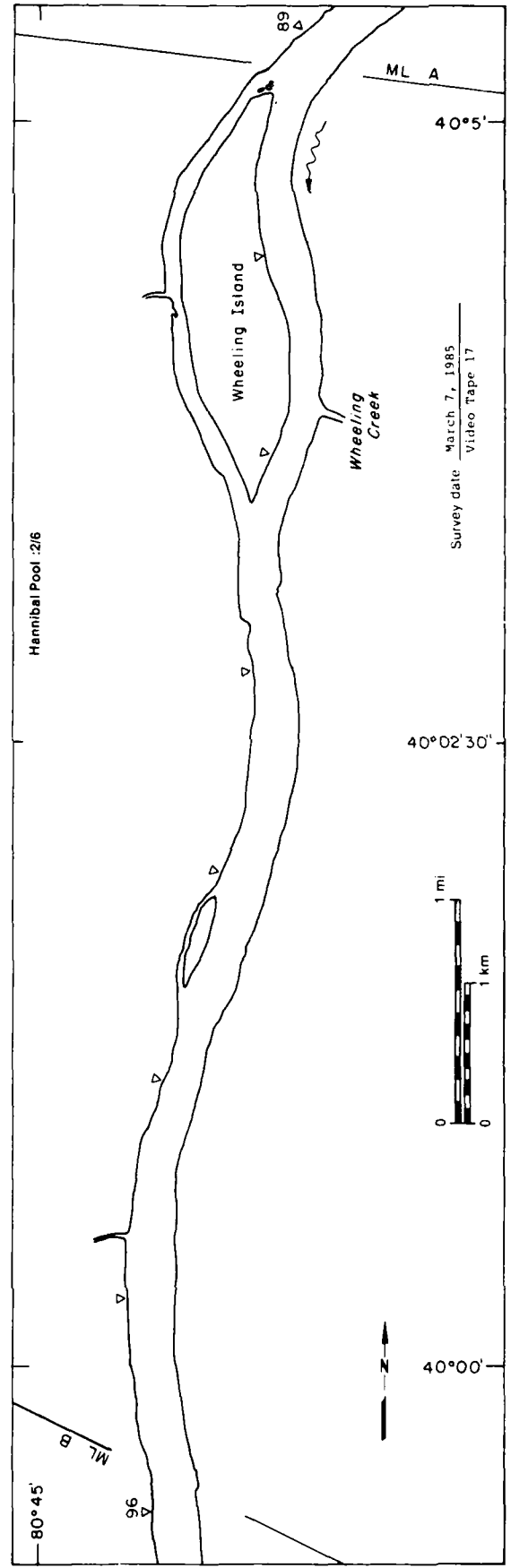
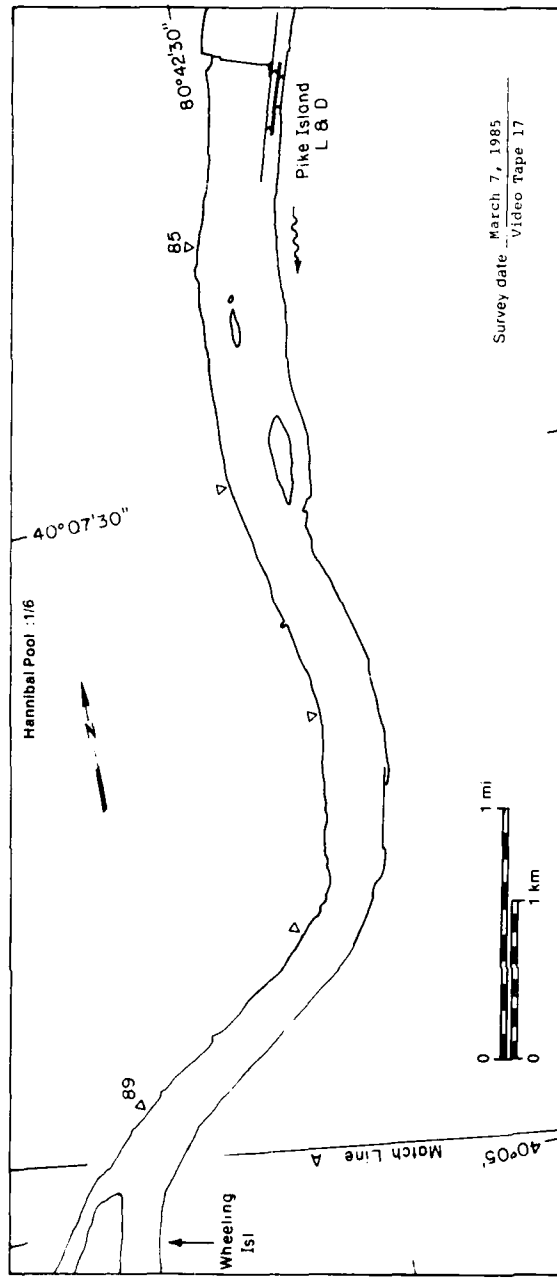
7 March 1985

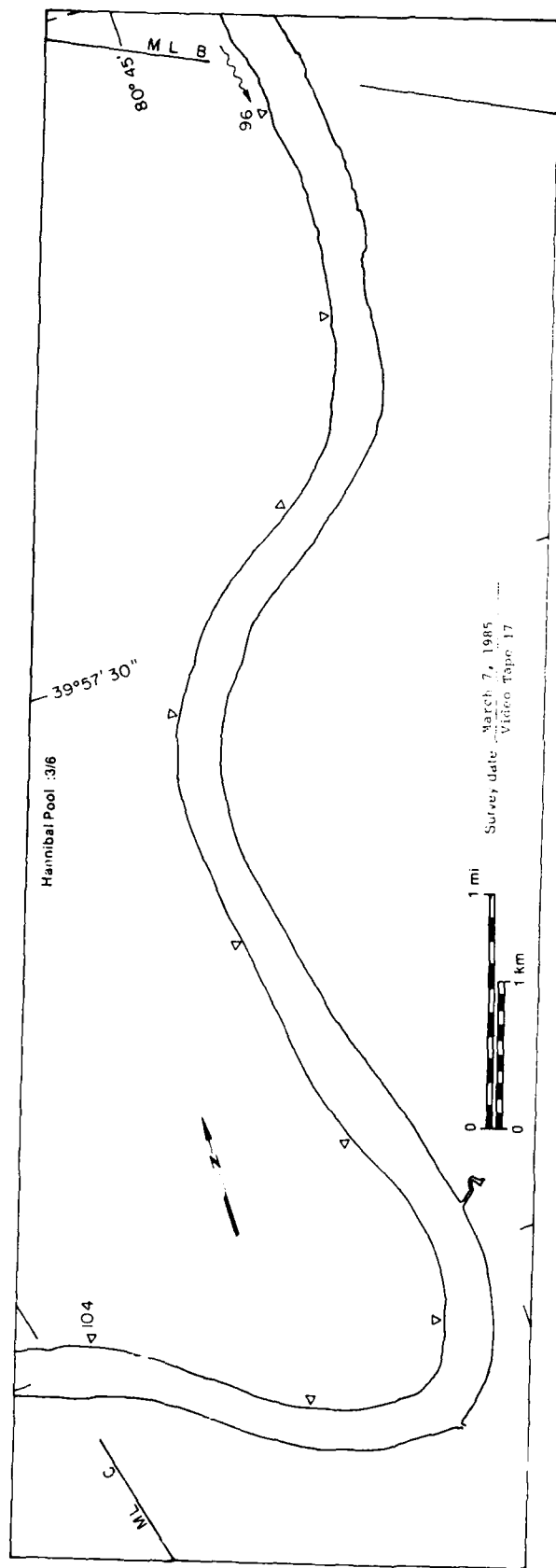
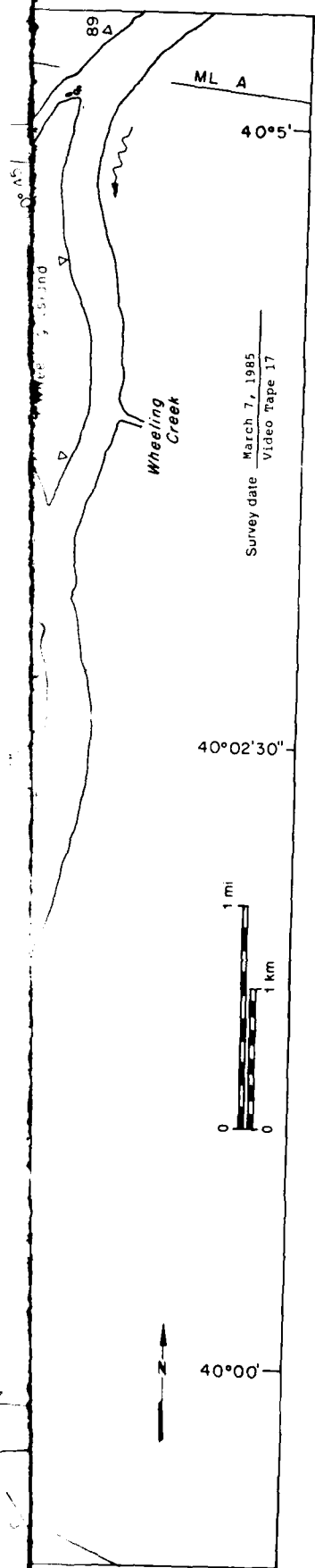




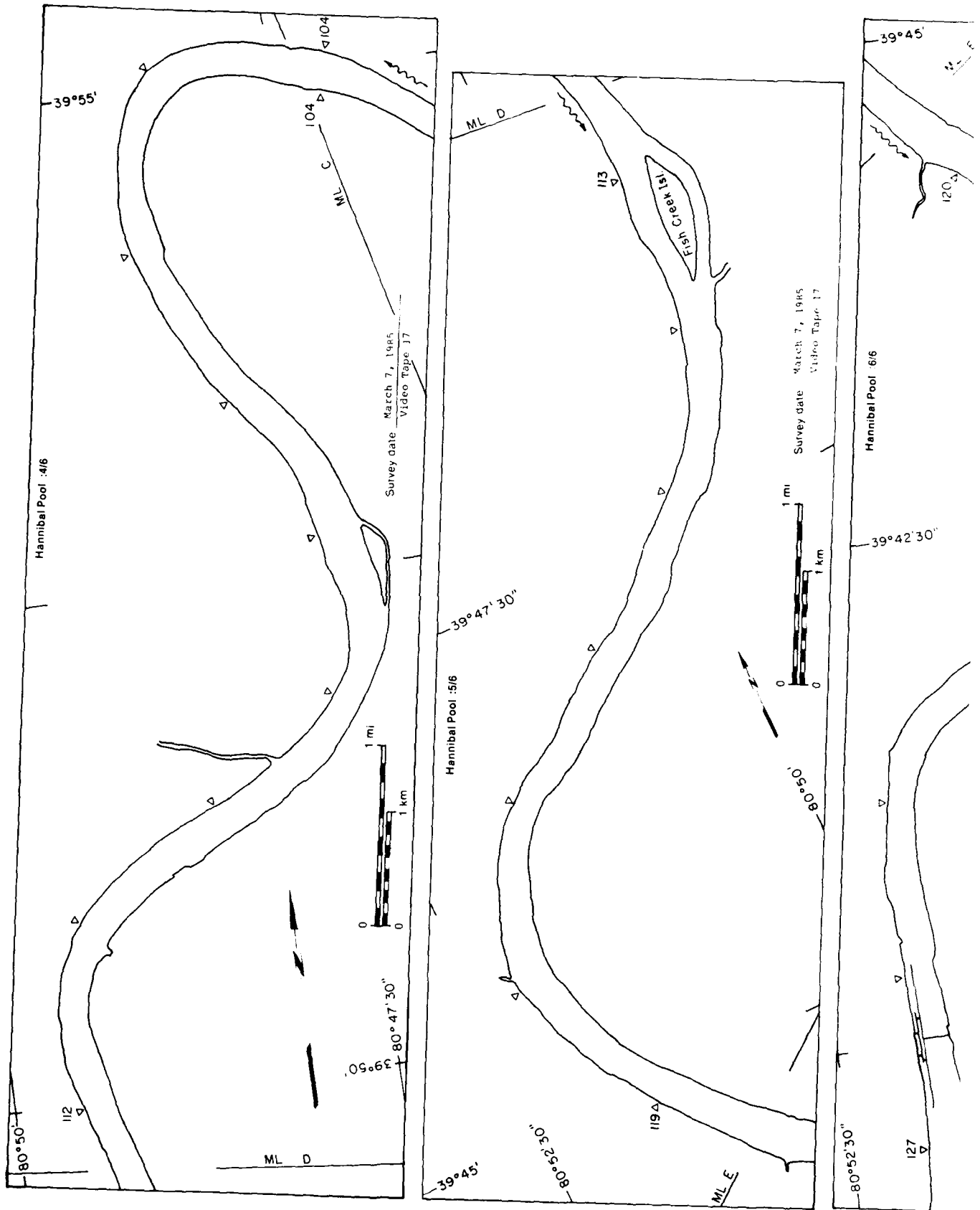
Pike Island Pool		Surface concentration	
MAP UNITS	Area (m ² x 10 ⁶)	Area (m ² x 10 ⁶)	Concentration (%)
Open water	18.92	NA	NA
Solid ice cover	—	NA	NA
Solid ice cover with open water areas	—	—	—
Fragmented ice cover	—	NA	NA
Fragmented ice cover with open water areas	—	—	—
Ice floes or frazil slush and pans	—	—	—
Total Area (m ² x 10 ⁶)	18.92		

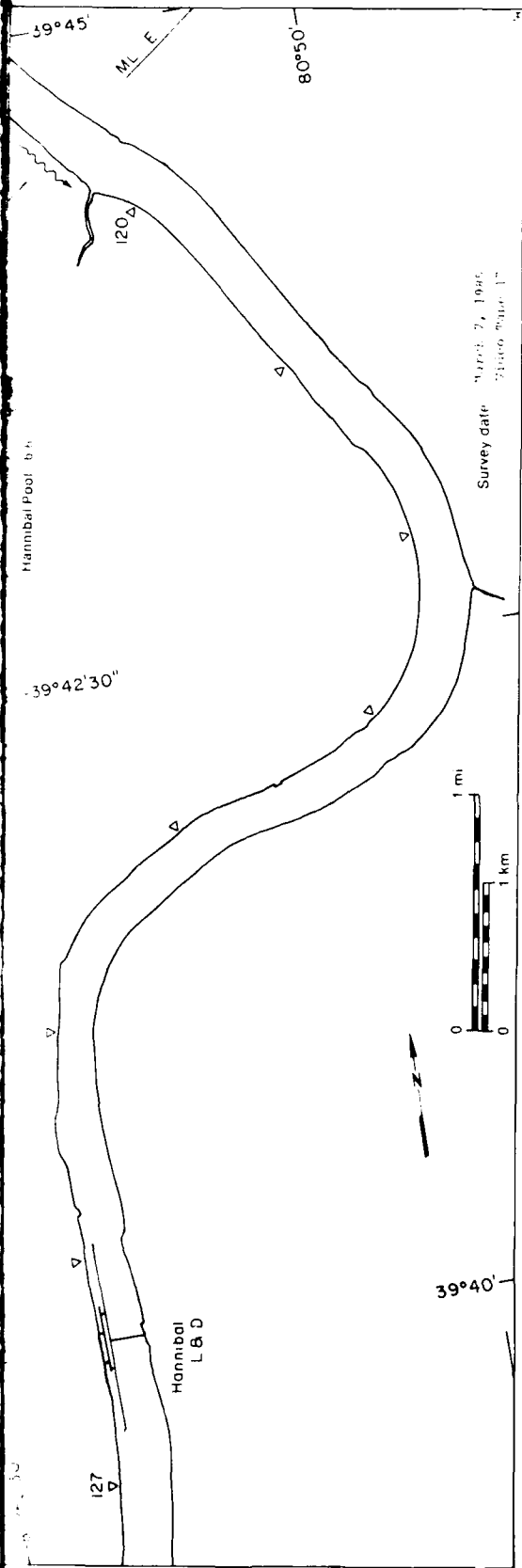
7 March 1985





7 March 1985

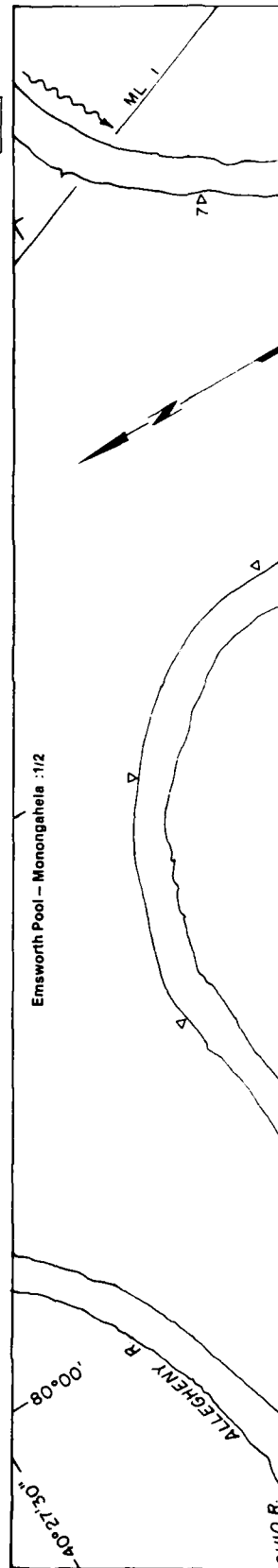
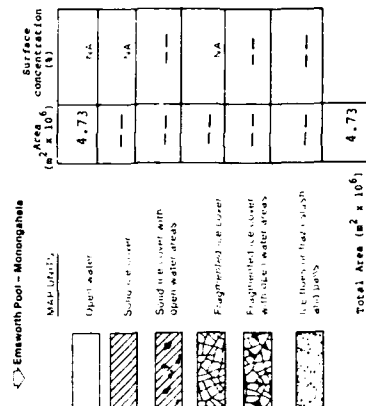
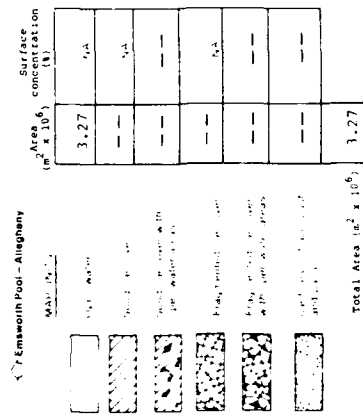


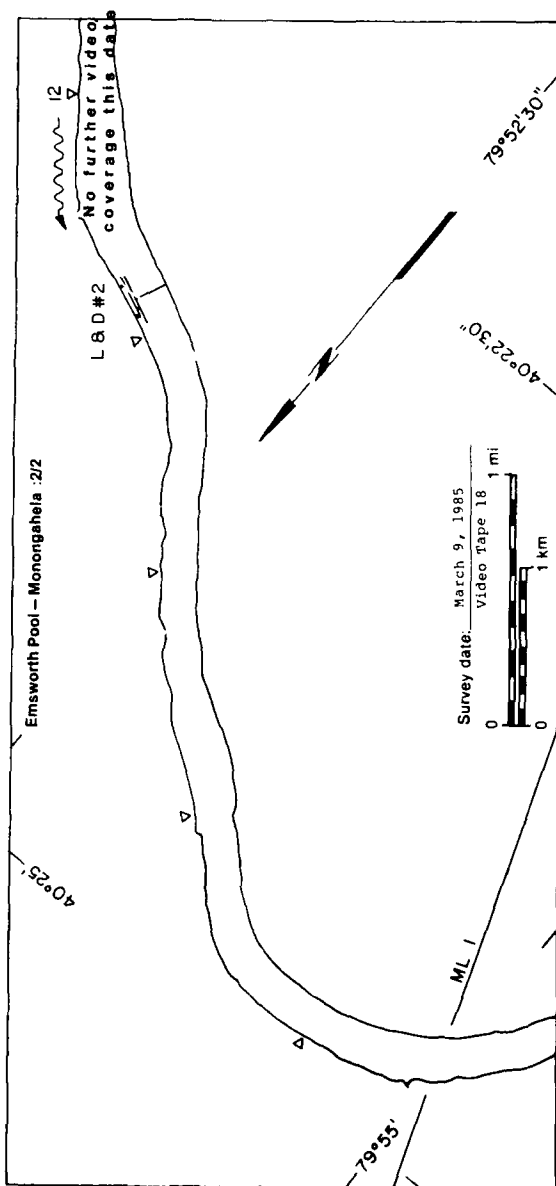
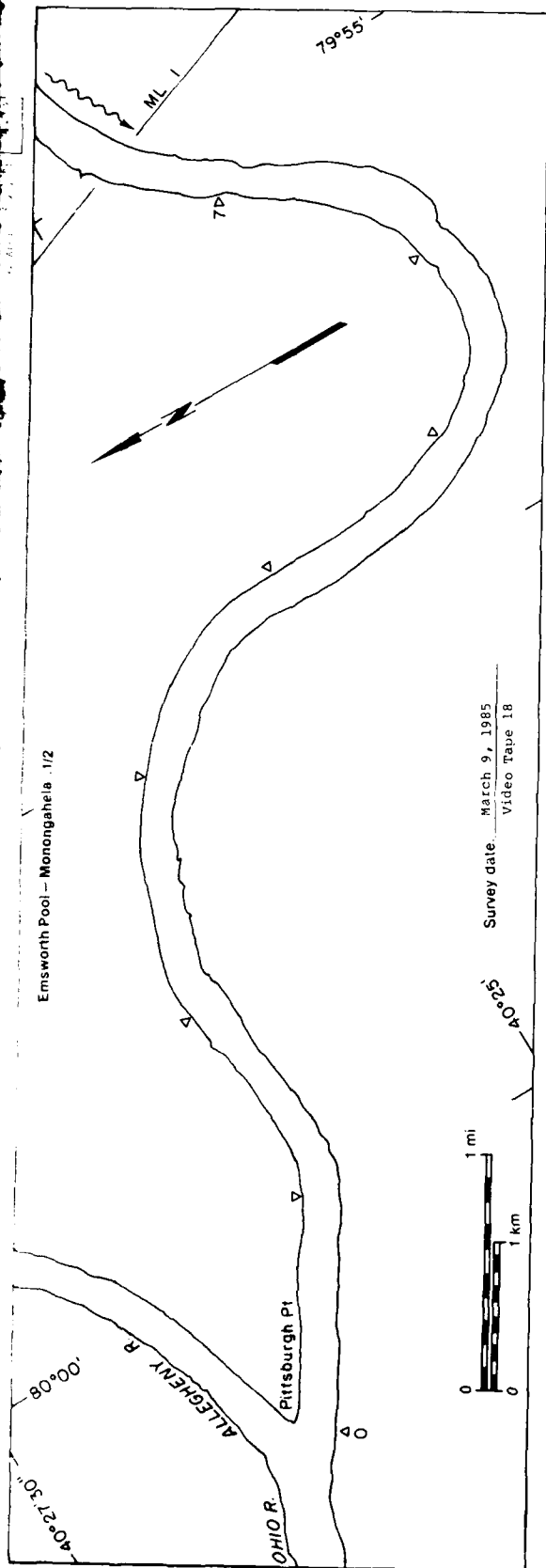


Hannibal Pool

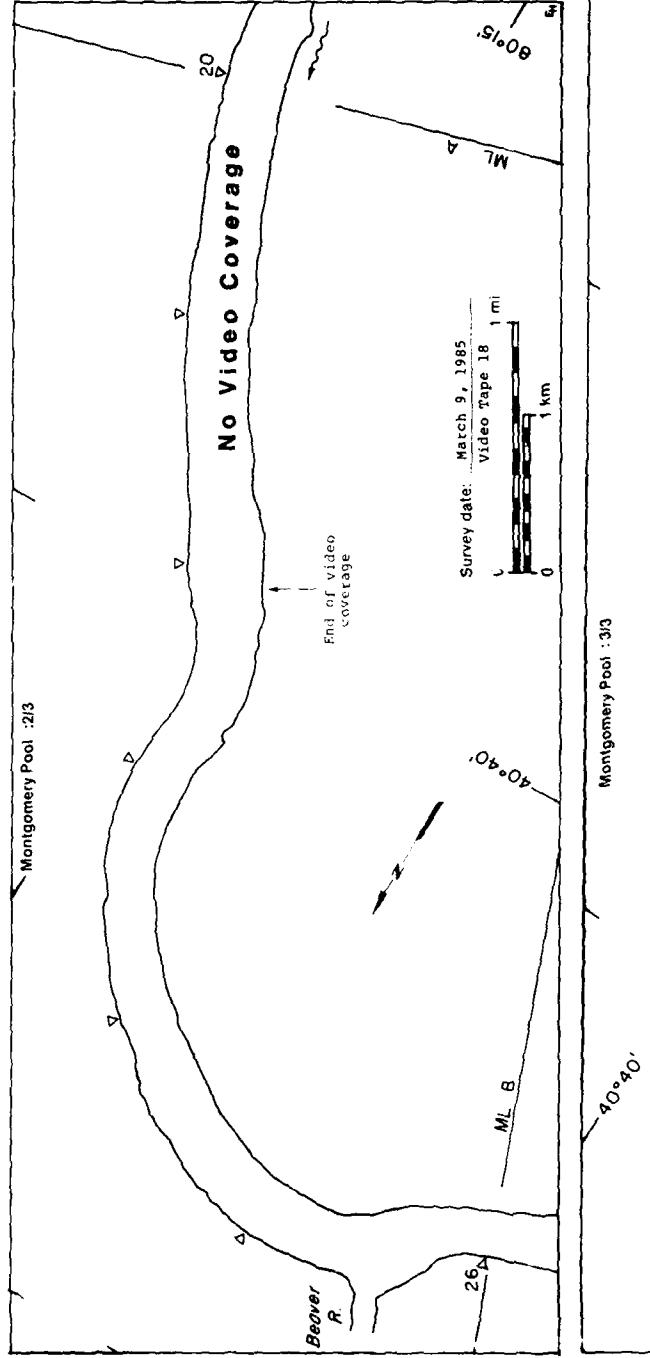
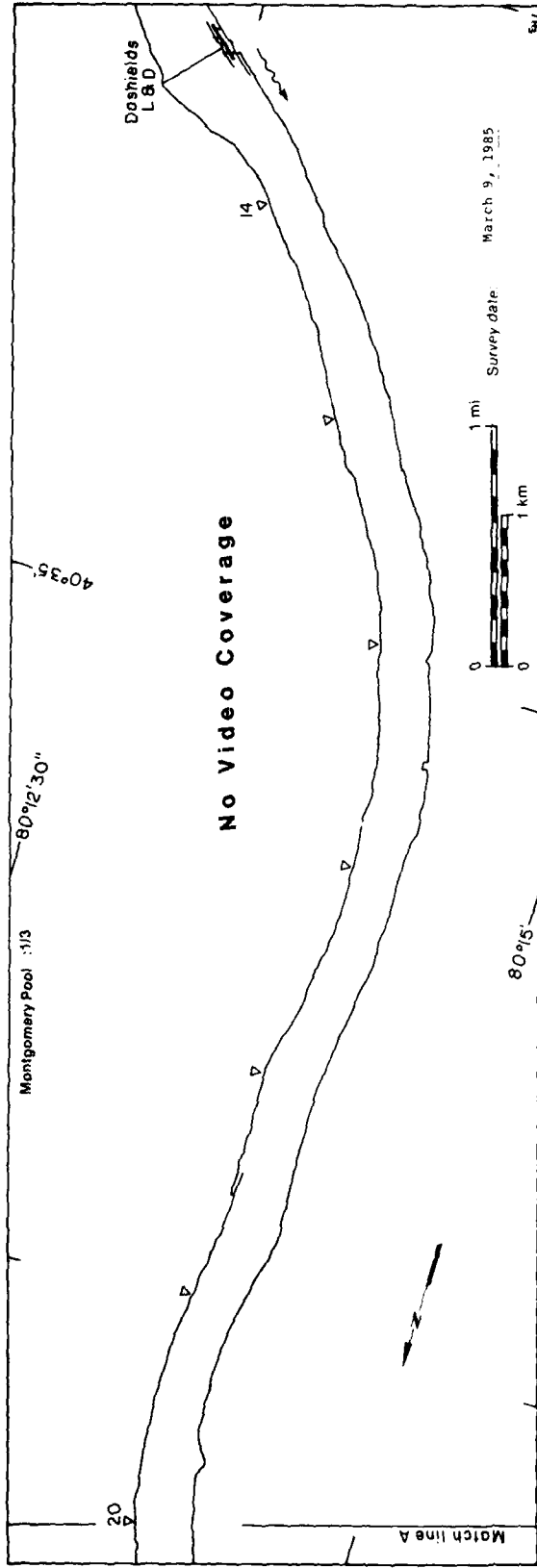
MAP UNITS	Area (m ² x 10 ⁶)	Surface concentration (g)
Open water	22.46	NA
Solid ice cover	—	NA
Solid ice open with open water areas	—	—
Fragmented ice cover	—	NA
Fragmented ice cover with open water areas	—	—
Solid ice cover with open water areas	—	—
Total Area (m ² x 10 ⁶)	22.46	

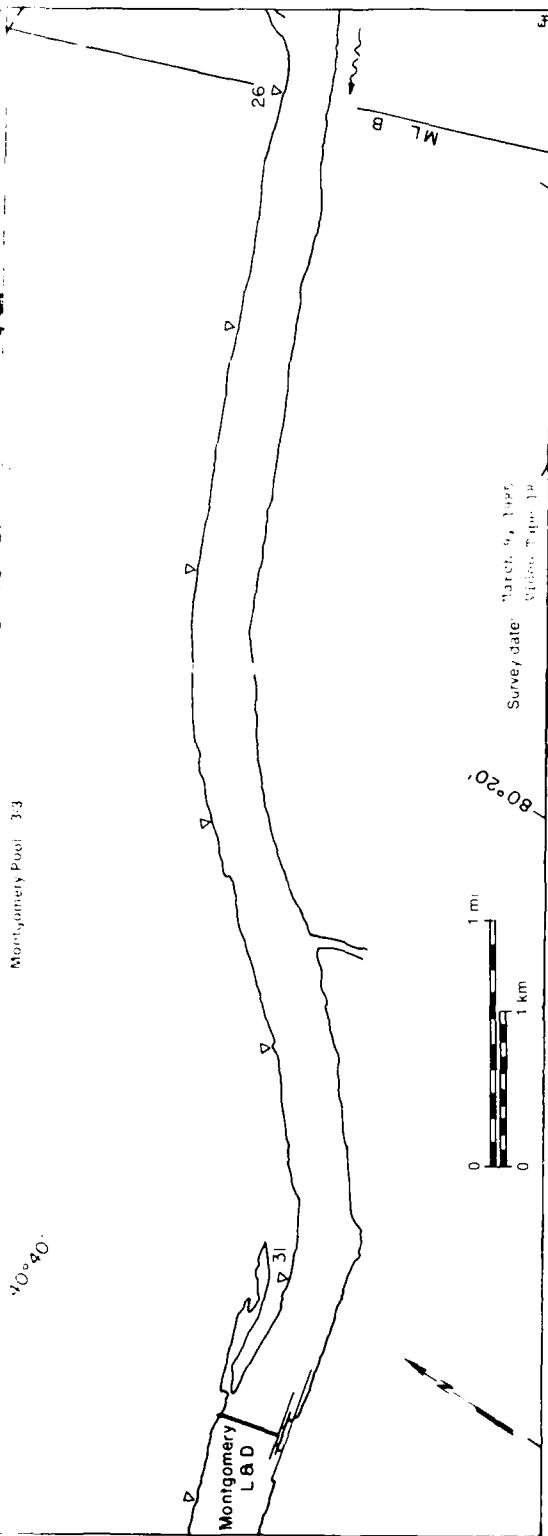
Map of the Ohio River and Monongahela River confluence area. The map shows the Ohio R and Monongahela R, with Pittsburgh Point marked. Key features include Sixmile Isl, Hers Isl, Lock 8, and Dam #2. The map includes a scale bar (0 to 1 km and 0 to 1 mi) and a north arrow. The survey date is March 10, 1985, and the video tape is 18. The map also shows the Ohio R and Monongahela R, and the location of Pittsburgh Point.





9 March 1985





Montgomery Pool

MAP UNITS

- Open water
- Solid ice cover
- Solid ice cover with open water areas
- Fragmented ice cover
- Fragmented ice cover with open water areas
- Ice floes or frazil slush and pans

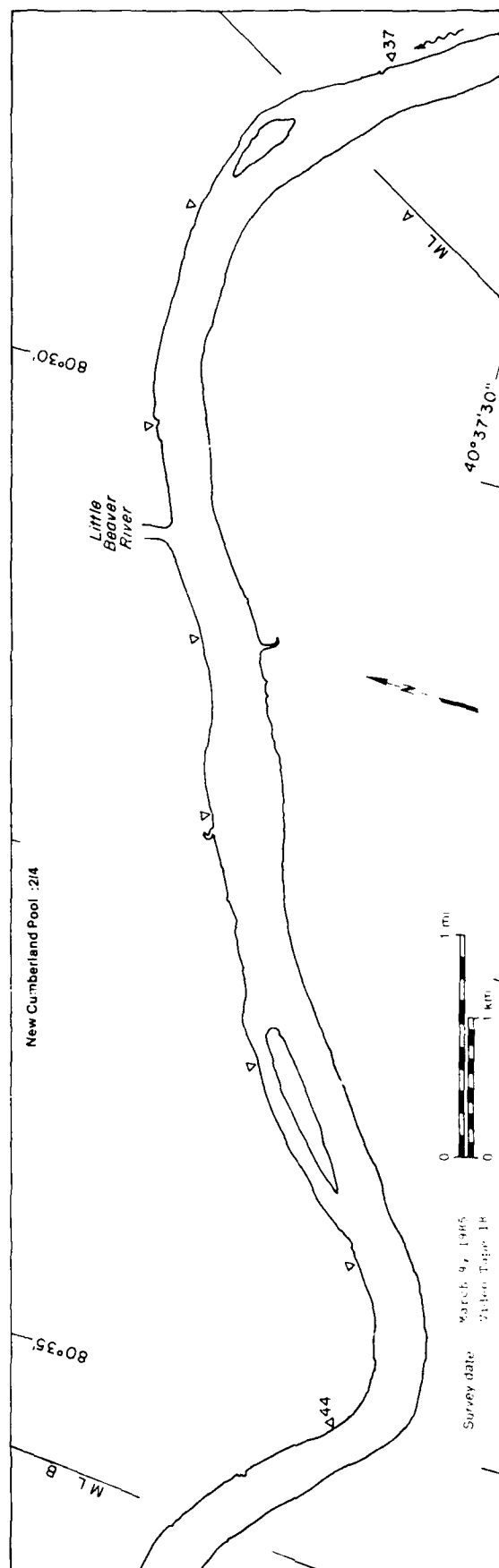
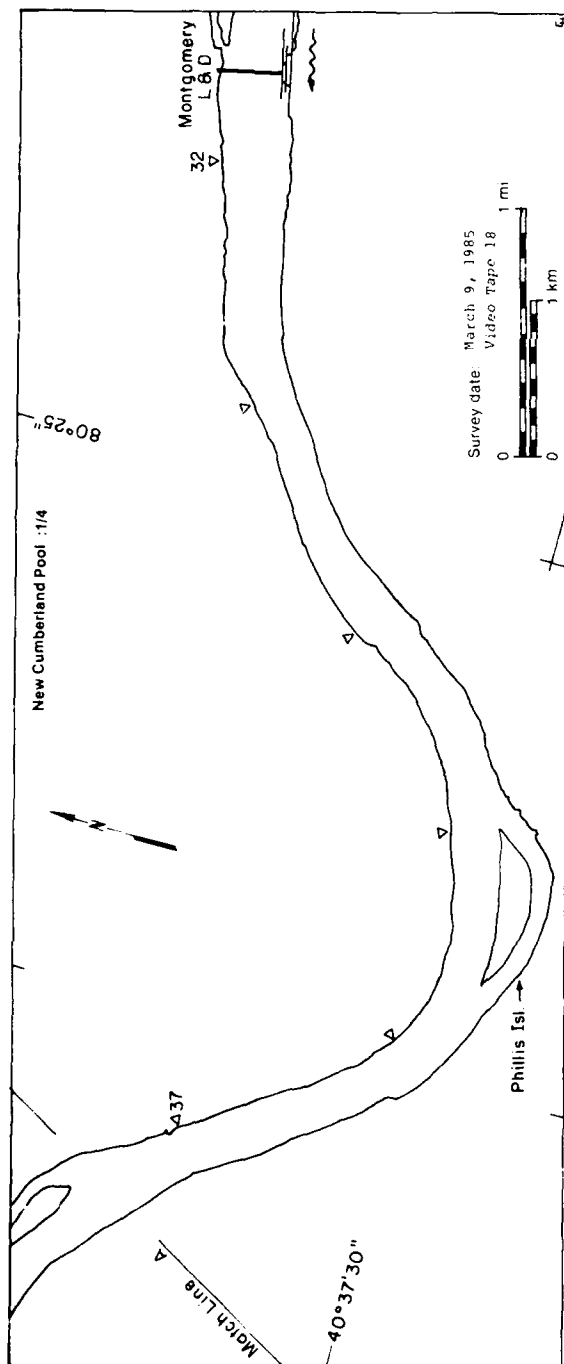
Surface concentration
(m² Area, 6,
(m² x 10⁶))

5.09	NA
---	NA
---	---
---	NA
---	---
---	---
11.27*	

Total Area (m² x 10⁶)

*includes 5.28 no video coverage

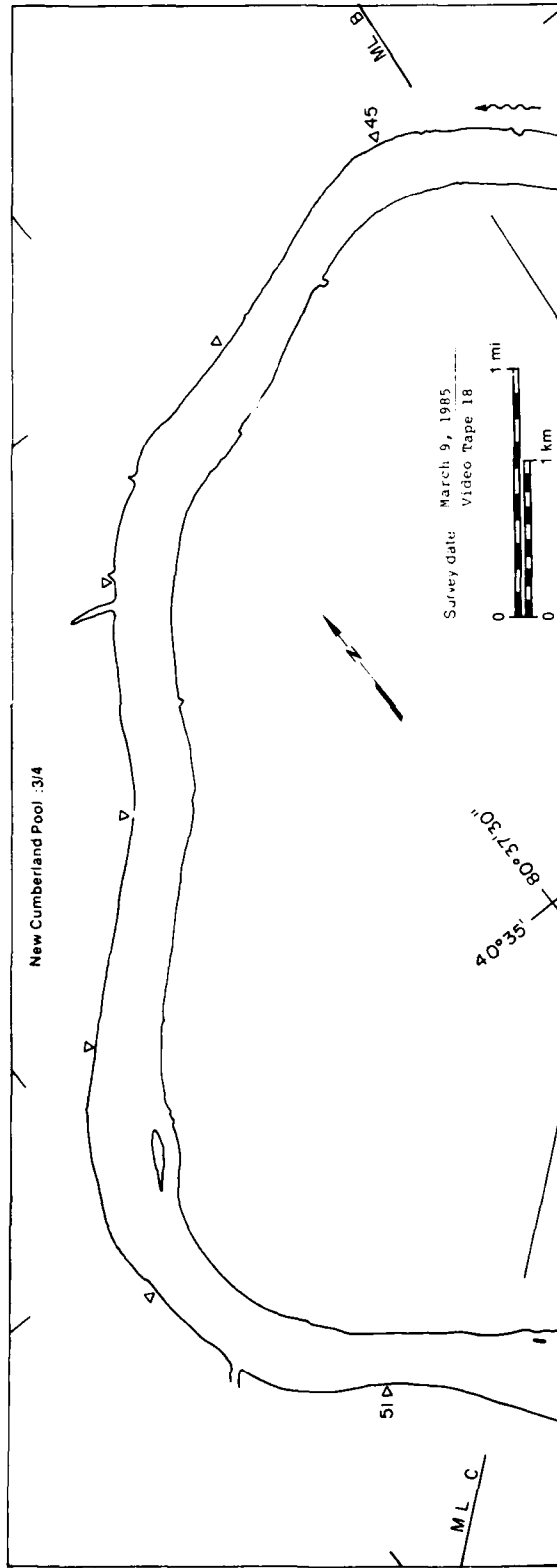
9 March 1985



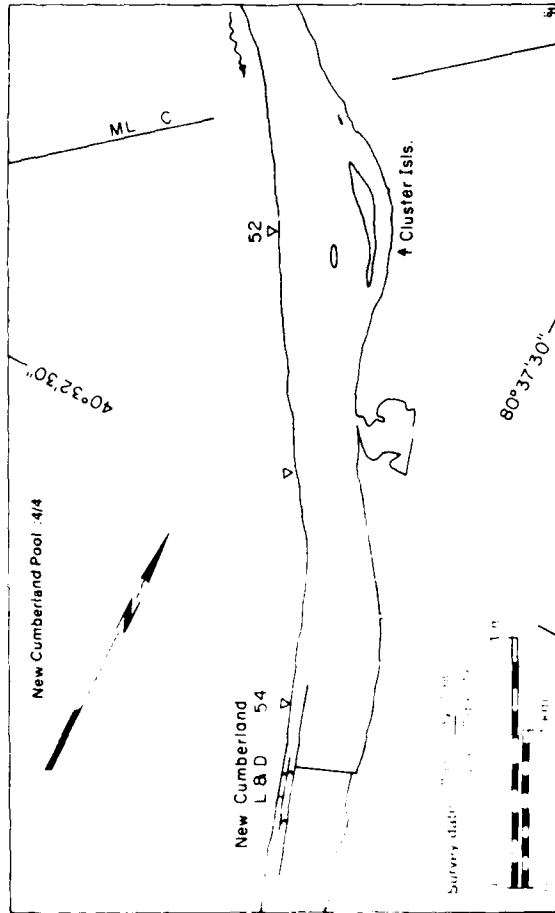
Survey date: March 9, 1985
Video Tape 18



40°37'30"



9 March 1985



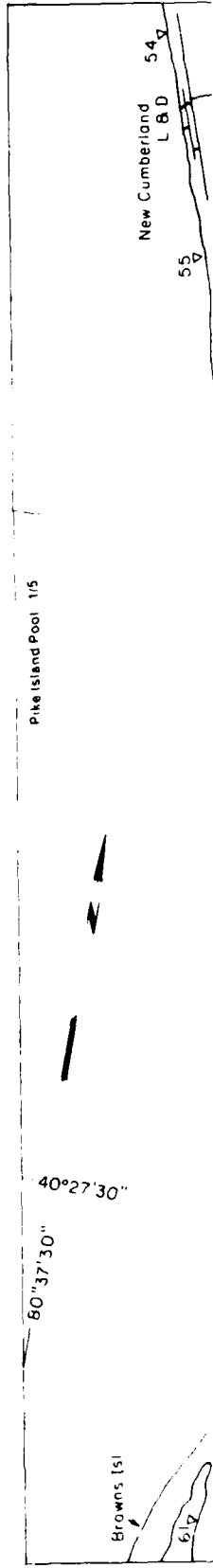
New Cumberland Pool

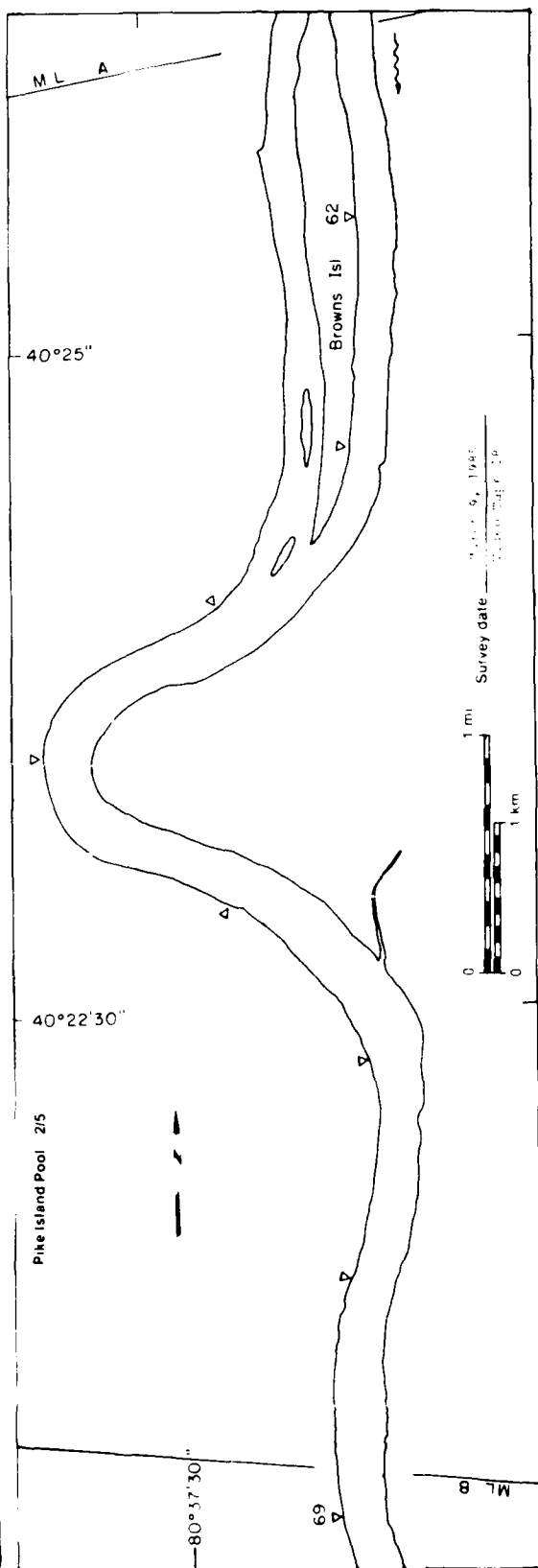
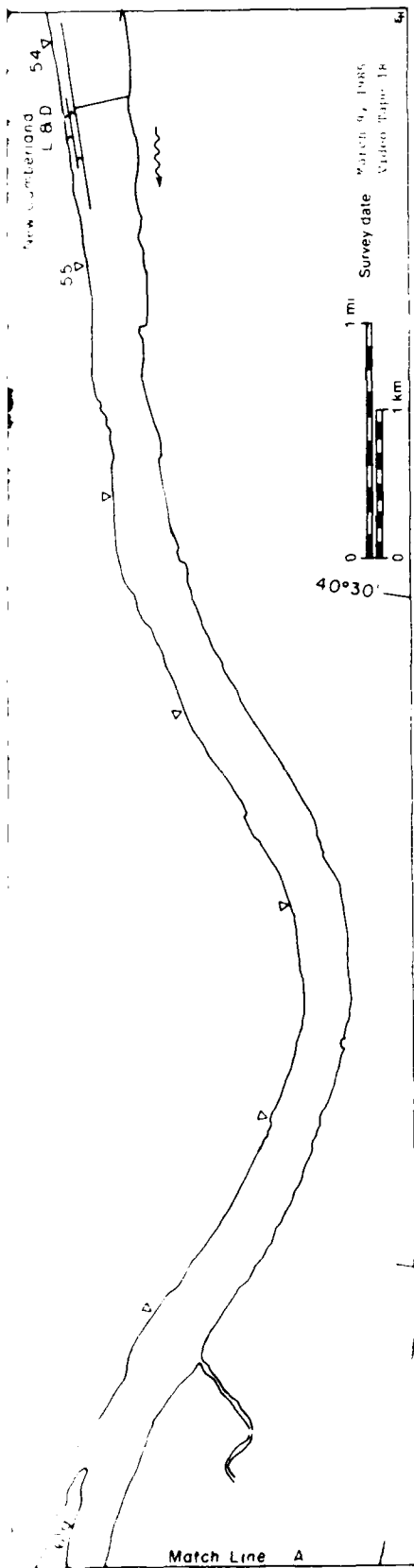
MAP UNITS



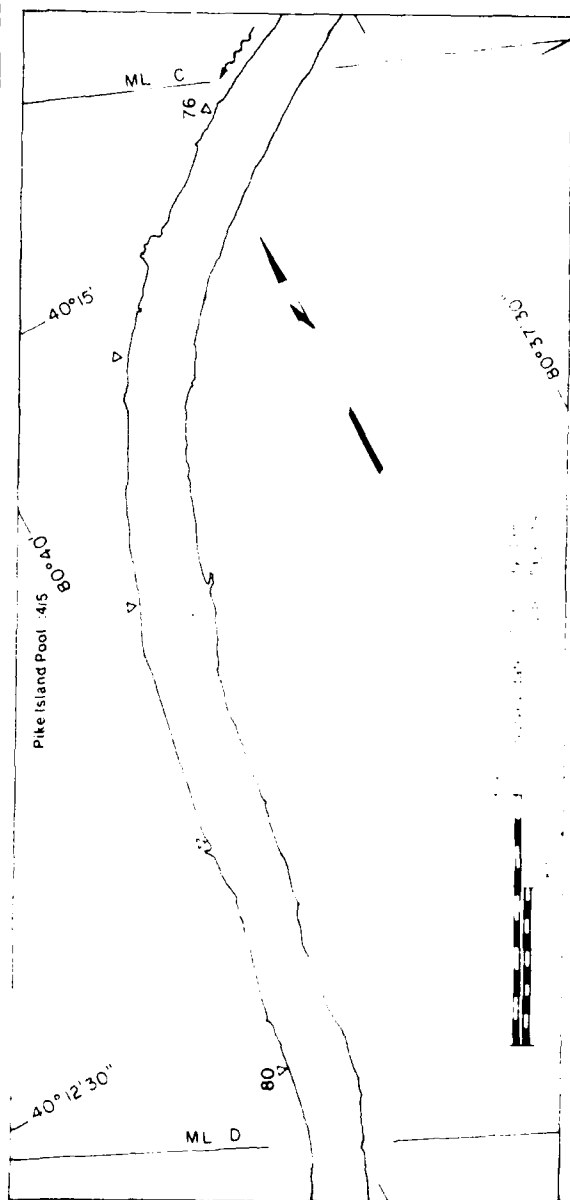
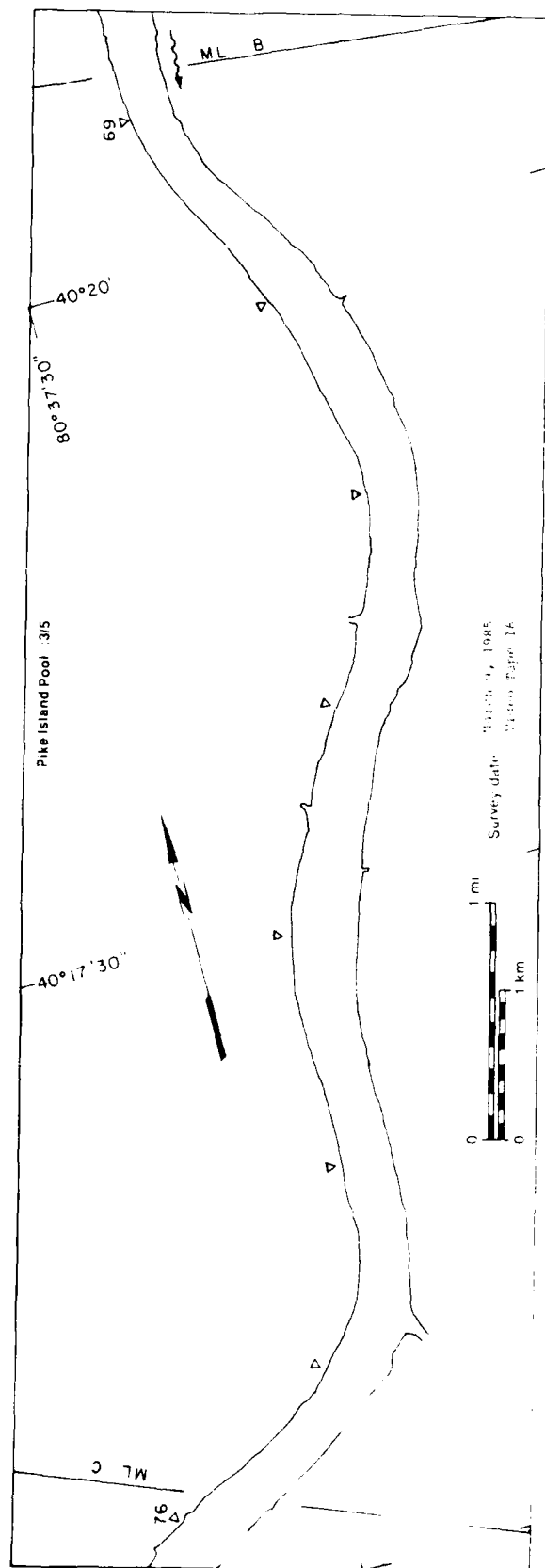
Area (m ² x 10 ⁶)	Surface concentration (%)
14.87	NA
---	NA
---	---
---	---
---	NA
---	---
---	---
14.87	

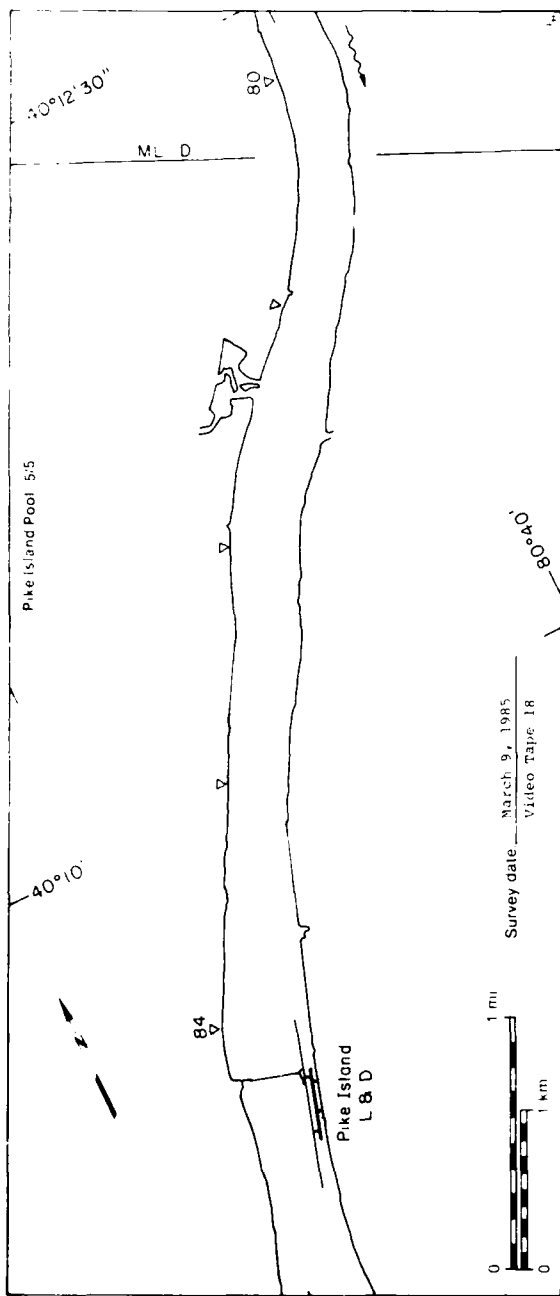
Total Area (m² x 10⁶)





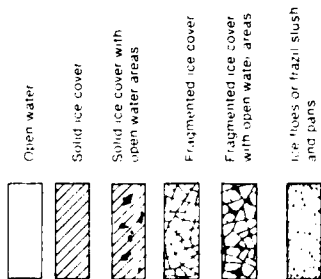
9 March 1985





Pike Island Pool

MAP UNITS

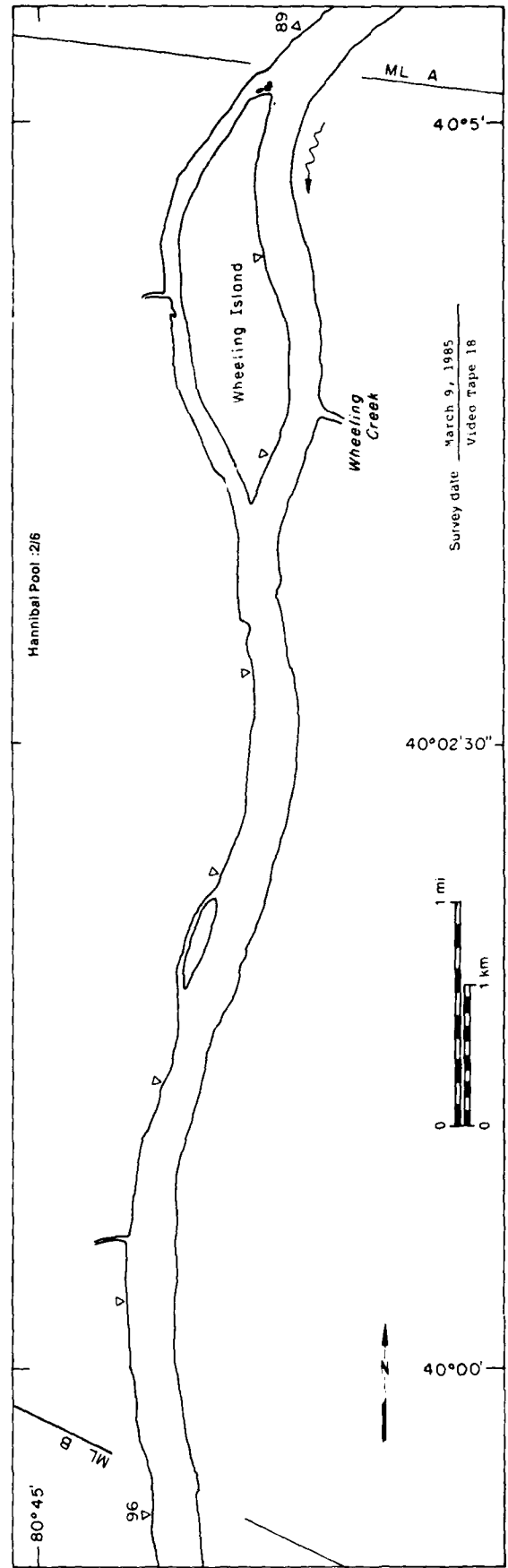
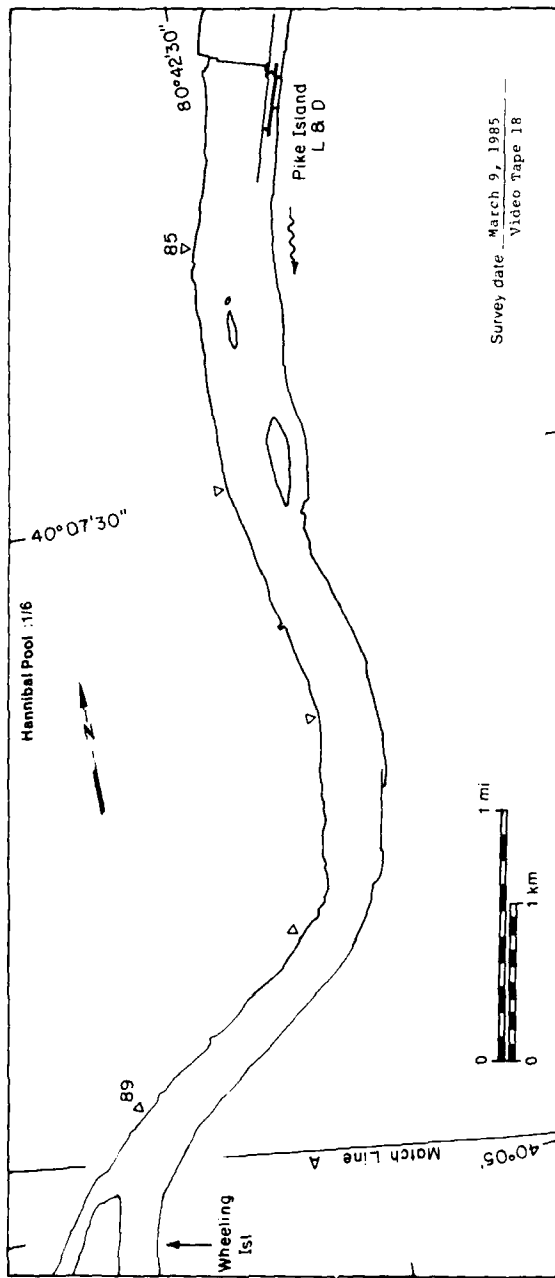


Area
($m^2 \times 10^6$)

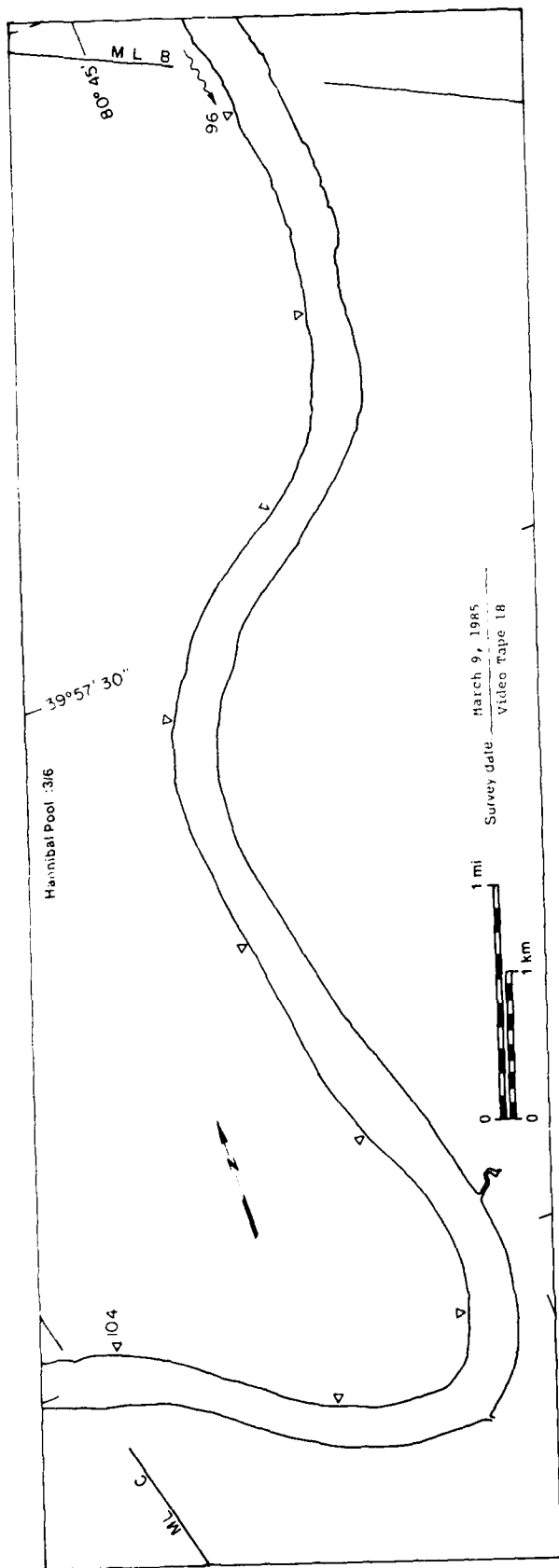
Area ($m^2 \times 10^6$)	Surface concentration (%)
18.92	NA
---	NA
---	---
---	NA
---	---
---	---
18.92	

Total Area ($m^2 \times 10^6$)

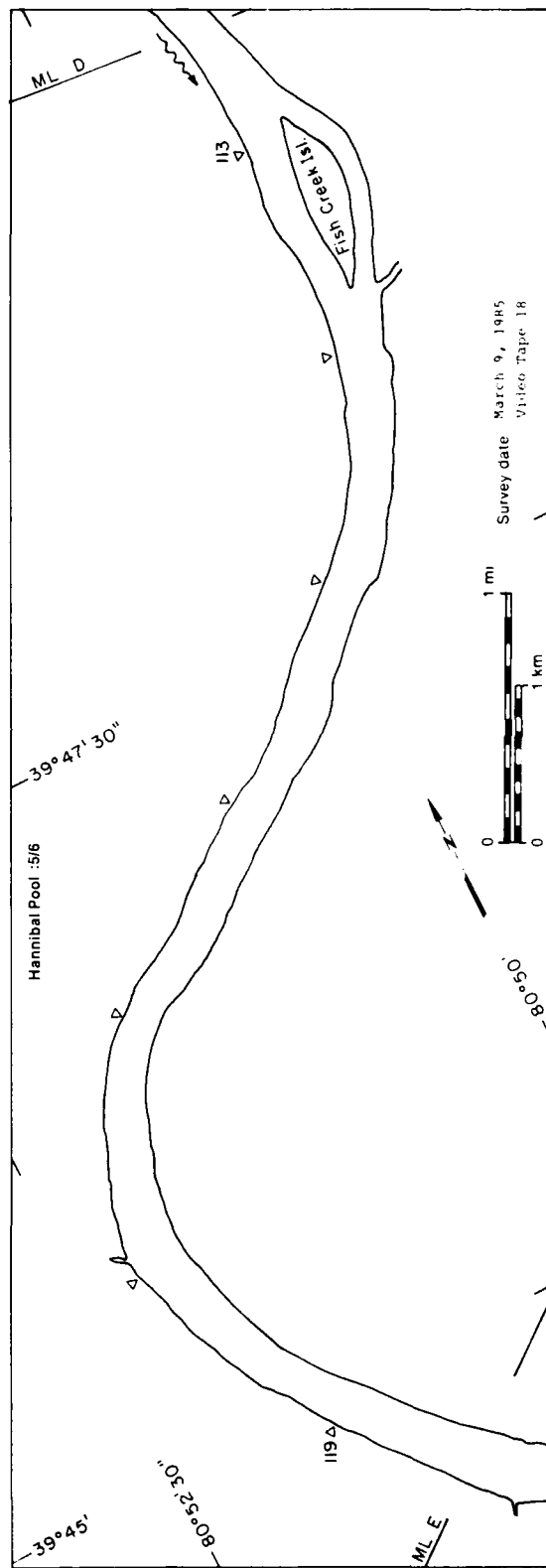
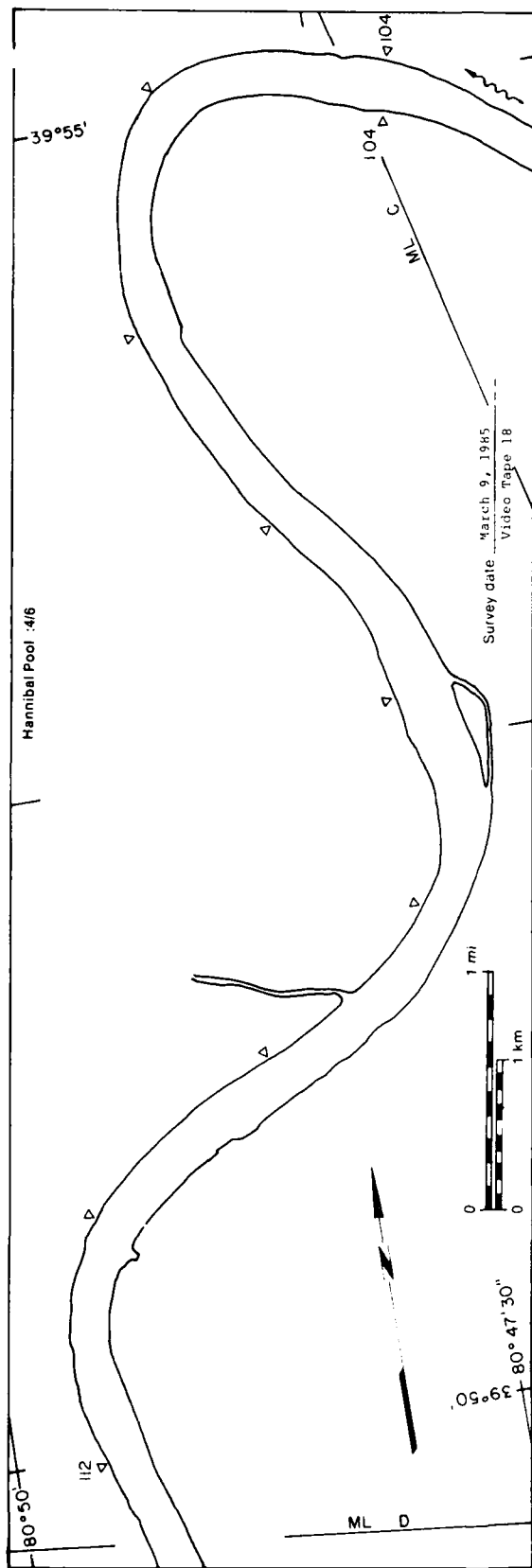
9 March 1985



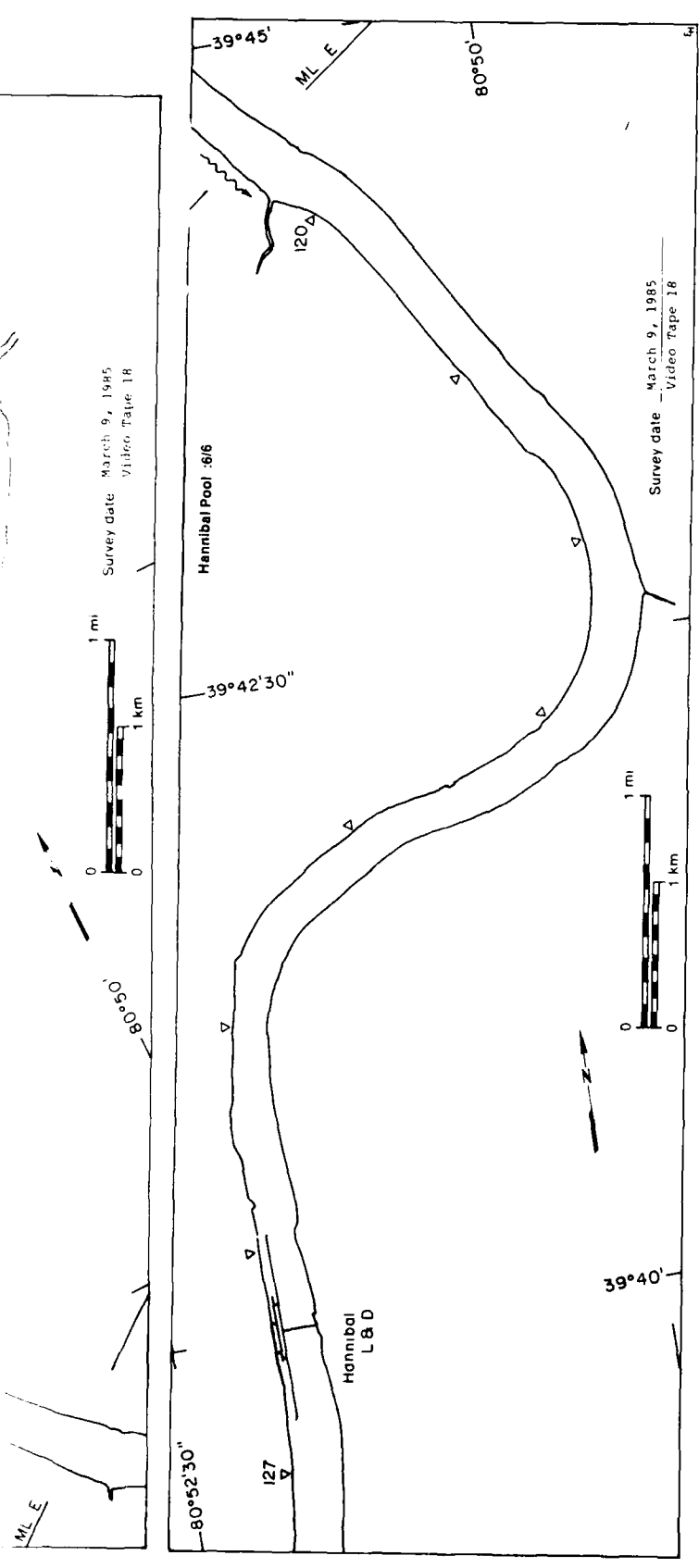
Hannibal Pool :3/6



9 March 1985



Hannibal



Hannibal Pool		Surface concentration
MAP UNITS	Area (m ² x 10 ⁶)	(%)
Open water	22.46	NA
Solid ice cover	---	NA
Solid ice cover with open water areas	---	---
Fragmented ice cover	---	NA
Fragmented ice cover with open water areas	---	---
Ice floes or frazil slush and pans	---	---
Total Area (m ² x 10 ⁶)		22.46

APPENDIX A: AREAS OF MAPPED ICE UNITS

See Table 1 for descriptions

For summary of Appendix A data, see inside back cover

Emsworth Pool - Allegheny River (area = $3.27 \times 10^6 \text{ m}^2$)

Video acquisition date	Open water		Solid ice cover		Fragmented ice cover		Ice floes or frazil slush and pans		Total ice area**
	Total area (10^6 m^2)	area* (10^6 m^2)	Total area (10^6 m^2)	ice conc. (%)	Total area (10^6 m^2)	ice conc. (%)	Total area (10^6 m^2)	ice conc. (%)	
January 23	0.15	0.14	0		2.42	0.55	0		3.09
January 24	0.16	0.29	0.16	80	2.27	0.39	0		3.06
January 28	0.18	0.07	0.12	80	2.36	0.55	0	0	3.03
January 29	0.15	0.09	0.14	80	2.26	0.53	0		3.03
January 30	0.23	0.18	0.14	85	2.13	0.58	0	0	2.98
February 4	0.55	1.95	0.07	0.5	0.05	0.59	0	5	2.57
February 8	1.22	0.28	0			1.22	0	0	1.71
February 19	3.14	0.27	0		0.05	0.55	0	2	0.10
February 22	3.02	0	0		0.01	0.02	0	1	0.02
February 23	1.17	0	0		0	0.02	0	5	0.11
February 24	0.25	0	0		0	0	0	1	0.03
February 28	3.27	0	0		0	0	0		0
March 1	3.27	0	0		0	0	0		0
March 2	3.27	0	0		0	0	0		0
March 3	3.27	0	0		0	0	0		0
March 6	3.27	0	0		0	0	0		0
March 7	3.27	0	0		0	0	0		0
March 10	3.27	0	0		0	0	0		0

*Total area equals ice area.

**Sum of all ice areas for all map units.

Emsworth Pool - Mononchela River (area = $4.73 \times 10^6 \text{ m}^2$)

Video acquisition date	Open water		Solid ice cover		Solid ice cover with open water areas		Frazil ice cover		Fragmented ice cover with open water areas		Ice floes or frazil slush and pans		Total ice area** (10 ⁶ m ²)
	Total area (10 ⁶ m ²)	area* (10 ⁶ m ²)	Total area (10 ⁶ m ²)	ice conc. (%)	Total area (10 ⁶ m ²)	ice conc. (%)	Total area (10 ⁶ m ²)	ice conc. (%)	Total area (10 ⁶ m ²)	ice conc. (%)	Total area (10 ⁶ m ²)	ice area (10 ⁶ m ²)	
January 28	2.25	0	0	0	0	0	0.74	0	1.40	0	0	0.46	1.00
January 29	1.71	0	0	0	0	0	0.30	0	0.43	0	0	0.18	0.72
February 4	0.63	0	0	0	0	0	0.09	0	0.52	0	0	1.01	1.63
February 23	4.75	0	0	0	0	0	0	0	0	0	0	0	0
February 24	4.56	0	0	0	0	0	0	0	0	0	0	0	0

Video acquisition date	Open water area* (10 ⁶ m ²)	Solid ice cover (10 ⁶ m ²)	Solid ice cover with open water areas (10 ⁶ m ²)	Fragmented ice cover with open water areas (10 ⁶ m ²)	Ice floes or frazil slush and pans (10 ⁶ m ²)	Total ice area** (10 ⁶ m ²)
January 24	3.23	0	0	0	0	3.23
January 29	3.71	0	0	0	0	3.71
February 4	0.61	0	0	0	0	0.61
February 23	4.73	0	0	0	0	4.73
February 24	4.56	0	0	0	0	4.56
February 28	4.73	0	0	0	0	4.73
March 1	4.73	0	0	0	0	4.73
March 2	4.73	0	0	0	0	4.73
March 3	4.73	0	0	0	0	4.73
March 6	4.73	0	0	0	0	4.73
March 7	4.73	0	0	0	0	4.73
March 10	4.73	0	0	0	0	4.73

*Total area equals ice area.

**Sum of all ice areas for all map units.

Lock and Dam 2 Pool - Monongahela River (area = 4.77 x 10⁶ m²)

Video acquisition date	Open water area* (10 ⁶ m ²)	Solid ice cover (10 ⁶ m ²)	Solid ice cover with open water areas (10 ⁶ m ²)	Fragmented ice cover with open water areas (10 ⁶ m ²)	Ice floes or frazil slush and pans (10 ⁶ m ²)	Total ice area** (10 ⁶ m ²)
January 28	4.36	0	0	0	0	4.36
January 29	4.38	0	0	0	0	4.38
February 4	0.07	0.03	0	0	0	0.10
February 23	4.00	0	0	0	0	4.00
February 24	4.77	0	0	0	0	4.77

*Total area equals ice area.

**Sum of all ice areas for all map units.

Lock and Dam 3 Pool - Monongahela River (area = $6.64 \times 10^6 \text{ m}^2$)

Video acquisition date	Open water		Solid ice cover		Fragmented ice cover		Ice floes or frazil slush and pans		Total ice area**
	area		area		area		area		
	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)
January 28	1.74	0.21	0	0	2.15	1.19	0.80	20	3.36
January 29	0.44	1.76	0.06	30	2.15	2.04	1.24	30	5.86
February 4	1.61	0.04	0.06	0	1.22	1.03	1.45	10	3.00
February 23	6.64	0	0	0	0	0	0	0	0
February 24	6.64	0	0	0	0	0	0	0	0

*Total area equals ice area.

**Sum of all ice areas for all map units.

Lock and Dam 4 Pool - Monongahela River (area = $6.60 \times 10^6 \text{ m}^2$)

Video acquisition date	Open water		Solid ice cover		Solid ice cover with open water areas		Frag. ice cover		Fragmented ice cover with open water areas			Ice floes or frazil slush and pans			Total ice area** (10 ⁶ m ²)
	Total area (10 ⁶ m ²)	%	Total area (10 ⁶ m ²)	%	Total area (10 ⁶ m ²)	conc. (10 ⁶ m ²)	Total area (10 ⁶ m ²)	conc. (%)	Total area (10 ⁶ m ²)	ice area (10 ⁶ m ²)	ice conc. (10 ⁶ m ²)	ice area (10 ⁶ m ²)	ice conc. (%)		
January 28	0.77	4.19	0	0	0	0	1.61	80	1.29	0.03	2	0	5.48		
January 29	0.08	3.71	0.08	60	0.05	1.65	1.10	95	1.05	0			6.44		
February 4	1.09	1.11	0.03	90	0.03	0.56	3.26	80	2.61	0.55	30	0.17	4.48		
February 23	6.60	0	0	0	0	0	0	0	0	0	0	0	0		
February 24	6.60	0	0	0	0	0	0	0	0	0	0	0	0		

*Total area equals ice area.

**Sum of all ice areas for all map units.

Maxwell Pool - Monongahela River (area = $1.56 \times 10^6 \text{ m}^2$)†

Video acquisition date	Open water		Solid ice cover		Total ice cover		Fragmented ice cover		Ice floes or frazil slush and pans		Total ice area**
	area		area		area		area		area		
	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)	(10^6 m^2)
January 28	1.56	0	0	0	0	0	0	0	0	0	0
January 29	0.08	0.08	0.08	60	0.05	1.65	1.10	95	0	0	6.44
February 4	1.09	1.11	0.03	90	0.03	0.56	3.26	80	0.55	30	4.48
February 23	6.60	0	0	0	0	0	0	0	0	0	0
February 24	6.60	0	0	0	0	0	0	0	0	0	0

†

Maximum total = 400,000,000 m² (area = 100 x 10⁶ m²)

Video acquisition date	Open water		Solid ice cover		Fragm. ice cover		Ice floes or frazil slush and pans		Total ice area** (10 m ²)
	area (10 ⁶ m ²)		Total area (10 ⁶ m ²)		Total area (10 ⁶ m ²)		Total area (10 ⁶ m ²)		
	area	conc. (%)	area	conc. (%)	area	conc. (%)	area	conc. (%)	
January 28	0.05	1.08	0	0	0.43	80	0.34	0	1.42
January 29	0	0.95	0	0	0.44	95	0.42	0	1.54
February 4	0.17	0.42	0	0	0.97	80	0.78	0	1.20
February 23	1.12	0	0	0	0	0	0.44	5	0.02
February 24	1.56	0	0	0	0	0	0	0	0

*Total area equals ice area.

**Sum of all ice areas for all map units. If foot only from mile 61.2 to mile 66.

Video acquisition date	Open water		Solid ice cover		Frag. ice cover		Fragmented ice cover with open water areas		Ice floes or frazil slush and pans		Total ice area**
	Total area (10 ⁶ m ²)	area* (10 ⁶ m ²)	Total area (10 ⁶ m ²)	conc. area (10 ⁶ m ²)	Total area* (10 ⁶ m ²)	conc. area (10 ⁶ m ²)	Total area (10 ⁶ m ²)	conc. area (10 ⁶ m ²)	Total area (10 ⁶ m ²)	conc. area (10 ⁶ m ²)	

Racine Pool - Ohio River (area = 19.89 x 10⁶ m²)

February 18	19.51	0	0	0	0	0	0.38	5	0.02	0.02	
-------------	-------	---	---	---	---	---	------	---	------	------	--

Gallipolis Pool - Ohio River (area = 24.65 x 10⁶ m²)

February 18	24.65	0	0	0	0	0	0	0	0	0	
-------------	-------	---	---	---	---	---	---	---	---	---	--

Greenup Pool - Ohio River (area = 41.19 x 10⁶ m²)

February 18	41.19	0	0	0	0	0	0	0	0	0	
-------------	-------	---	---	---	---	---	---	---	---	---	--

Meldahl Pool - Ohio River (area = 73.77 x 10⁶ m²)

February 18	73.77	0	0	0	0	0	0	0	0	0	
-------------	-------	---	---	---	---	---	---	---	---	---	--

* Total area equals ice area.
** Sum of all ice areas for all map units.

Emsworth Pool - Ohio River (area = 4.49 x 10⁶ m²)

Video acquisition date	Open water		Solid ice cover		Frag. ice cover		Fragmented ice cover with open water areas		Ice floes or frazil slush and pans		Total ice area**
	Total area (10 ⁶ m ²)	area* (10 ⁶ m ²)	Total area (10 ⁶ m ²)	conc. area (10 ⁶ m ²)	Total area* (10 ⁶ m ²)	conc. area (10 ⁶ m ²)	Total area (10 ⁶ m ²)	conc. area (10 ⁶ m ²)	Total area (10 ⁶ m ²)	conc. area (10 ⁶ m ²)	
January 30	0.28	1.70	0	0	0	0	2.42	80	1.14	0	3.73
February 16	0.08	0	0	0	0.12	0	3.10	60	1.31	0	2.23
February 19	4.39	0	0	0	0.02	0	0	0	0.01	0	0.02
February 20	0.60	0	0	0	0	0	0	0	3.90	0	0.10
March 5	4.40	0	0	0	0	0	0	0	0	0	0

* Total area equals ice area.
** Sum of all ice areas for all map units.

Gallipolis Pool - Ohio River (area = 24.65 x 10⁶ m²)

Date	Open water area (10 ⁶ m ²)	Solid ice cover area (10 ⁶ m ²)	Solid ice cover with open water areas (10 ⁶ m ²)	Fragmented ice cover area (10 ⁶ m ²)	Fragmented ice cover with open water areas (10 ⁶ m ²)	Ice floes or frazil slush and pans area (10 ⁶ m ²)	Total ice area (10 ⁶ m ²)
January 30	0.28	1.00	0	0.47	0.47	0	1.75
February 16	2.04	0	0	3.10	3.10	0	5.14
February 19	4.40	0	0	0.02	0.02	2	6.42
February 20	0.60	0	0	0	0	3.80	4.40
March 6	4.40	0	0	0	0	0	4.40

*Total area equals ice area.

**Sum of all ice areas for all map units.

Dashields Pool - Ohio River (area = 5.00 x 10⁶ m²)

Video acquisition date	Open water area (10 ⁶ m ²)	Solid ice cover area (10 ⁶ m ²)	Solid ice cover with open water areas (10 ⁶ m ²)	Fragmented ice cover area (10 ⁶ m ²)	Fragmented ice cover with open water areas (10 ⁶ m ²)	Ice floes or frazil slush and pans area (10 ⁶ m ²)	Total ice area (10 ⁶ m ²)
January 30	3.15	0.47	0	1.34	1.34	0.04	4.96
February 16	4.23	0	0	0.26	0.26	0.51	4.99
February 19	4.07	0	0	0	0	0.03	4.10
February 20	4.16	0	0	0	0	0.84	5.00
March 6	5.00	0	0	0	0	0	5.00

*Total area equals ice area.

**Sum of all ice areas for all map units.

Montgomery Pool - Ohio River (area = $11.27 \times 10^6 \text{ m}^2$)

Video acquisition date	Open water		Solid ice cover		Fragmented ice cover		Ice floes or frazil slush and pans		Total ice area** (10^6 m^2)
	area (10^6 m^2)	conc. (%)	area (10^6 m^2)	conc. (%)	area (10^6 m^2)	conc. (%)	area (10^6 m^2)	conc. (%)	
January 30	2.17	3.30	0	0	5.71	75	0.04	10	7.67
February 01	1.24	0	0	0	5.93	92	0	0	6.48
February 16	4.00	3.30	0	0	5.19	70	1.10	5	8.79
February 17*	3.62	0	0	0	0.28	90	0.30	10	0.29
February 19	11.27	0	0	0	0	0	0	0	0
February 20	11.27	0	0	0	0	0	0	0	0
February 21***	5.20	0	0	0	0	0	0	0	0
March 1†	5.02	0	0	0	0	0	0	0	0
March 2	11.27	0	0	0	0	0	0	0	0
March 3††	5.00	0	0	0	0	0	0	0	0
March 6	11.27	0	0	0	0	0	0	0	0
March 7††	5.01	0	0	0	0	0	0	0	0
March 11†	5.08	0	0	0	0	0	0	0	0

*Total area equals ice area.

**50% of all ice areas for all map units.

***5.07 $\text{m}^2 \times 10^6$ of ice h not covered on video tape.

†2.92 $\text{m}^2 \times 10^6$ of ice h not covered on video tape.

††7.18 $\text{m}^2 \times 10^6$ of ice h not covered on video tape.

†††2.24 $\text{m}^2 \times 10^6$ of ice h not covered on video tape.

††††2.29 $\text{m}^2 \times 10^6$ of ice h not covered on video tape.

New Cumberland Pool - Ohio River (area = $14.87 \times 10^6 \text{ m}^2$)

Video acquisition date	Open water		Solid ice cover		Fragmented ice cover		Ice floes or frazil slush and pans		Total ice area** (10^6 m^2)
	area (10^6 m^2)	conc. (%)	area (10^6 m^2)	conc. (%)	area (10^6 m^2)	conc. (%)	area (10^6 m^2)	conc. (%)	
January 30	2.01	6.30	0	0	5.22	20	0.07	5	10.64
February 01	5.20	2.10	0	0	5.20	90	0.06	5	9.76
February 16	1.24	1.20	0	0	5.30	90	1.04	10	4.50

Pike Island Pool - Ot to River (area = $18.92 \times 10^6 \text{ m}^2$)

[illegible]

*Total area equals ice area.

**Sum of all lce areas for all map units.
18.95 m² x 10⁶ of reach not covered on vi

Hannibal Pool - Ohio River (area = $22.46 \times 10^6 \text{ m}^2$)

[illegible]

Video acquisition date	Open water	Solid ice cover	Solid ice cover with open water areas	Frag. ice cover	Fragmented ice cover with open water areas	Ice floes or frazil slush and pans	Total ice area**
January 8	19.49	0.24	0	0.17	1.01	1.6	1.02
January 16	18.77	0.03	0	0	1.01	0.01	1.74
February 16	15.33	0	0	0	5.84	2.65	3.05
February 17	22.38	0.01	0	0	0.01	1.29	0.03
February 19	22.46	0	0	0	0	0.06	0
February 20	22.35	0	0	0	0	0.11	0
February 28	22.46	0	0	0	0	0	0
March 1	22.46	0	0	0	0	0	0
March 2	22.46	0	0	0	0	0	0
March 3	22.46	0	0	0	0	0	0
March 6	22.46	0	0	0	0	0	0
March 7	22.46	0	0	0	0	0	0
March 9	22.46	0	0	0	0	0	0

*Total area equals ice area.

**Sum of all ice areas for all map units.

Willow Island Pool - Ohio River (area = $21.24 \times 10^6 \text{ m}^2$)

Video acquisition date	Open water	Solid ice cover	Solid ice cover with open water areas	Frag. ice cover	Fragmented ice cover with open water areas	Ice floes or frazil slush and pans	Total ice area**
February 8	19.39	0	0	0.03	0.95	0.87	1.24
February 16	20.99	0.16	0	0.04	0.03	0.02	0.22
February 18	20.82	0	0	0	0.18	0.24	0.16
February 19	21.22	0	0	0	0	0.02	0
February 20	21.21	0.03	0	0	0	Trace	0.03

*Total area equals ice area.

**Sum of all ice areas for all map units.

Sellefville - Ohio River (area = $27.28 \times 10^6 \text{ m}^2$)

Aircraft acquisition date	Open water		Solid ice cover		Solid ice cover with open water areas		Frag. ice cover		Fragmented ice cover with open water areas		Ice floes or frazil slush and pans		Total ice area**
	Total area (10^6 m^2)	area* (10^6 m^2)	Total area* (10^6 m^2)	area* (10^6 m^2)	Total area* (10^6 m^2)	area* (10^6 m^2)	Total area* (10^6 m^2)	area* (10^6 m^2)	Total area* (10^6 m^2)	area* (10^6 m^2)	Total area* (10^6 m^2)	area* (10^6 m^2)	
February 9	24.02	0.31	0	0	0	0	0.11	0.37	60	0.22	1.57	30	1.11
February 16	27.02	0	0	0	0	0	0.26	4.65	50	2.33	0.34	5	2.61
February 19	26.16	0.02	0	0	0	0	0	0.35	80	0.28	0.15	2	0.30
February 20	27.22	trace	0	0	0	0	0	0.02	90	0.02	0.04	1	0.02
February 20	27.24	0	0	0	0	0	0	0	0	0.04	1	0	0

*Total area equals ice area.

**Sum of all ice areas for all map units.

APPENDIX B: VIDEO TAPE COVERAGE

<u>Tape Number</u>	<u>River</u>	<u>River Miles</u>	<u>Date</u>
1	Allegheny	0-6	23 January 85
2	Allegheny	0-7	24 January 85
	Monongahela	0-66	28 January 85
	Allegheny	0-7	28 January 85
	Monongahela	0-66	29 January 85
3	Ohio	126-0	30 January 85
	Allegheny	0-17	30 January 85
4	Allegheny	0-17	4 February 85
	Monongahela	0-66	4 February 85
	Ohio	205-135	8 February 85
5	Ohio	137-0 (missing 17-4)	8 February 85
	Allegheny	0-7	8 February 85
6	Ohio	204-0	16 February 85
7	Ohio	24-127	17 February 85
8	Ohio	127- 306	18 February 85
9	Ohio	305-396	18 February 85
10	Ohio	204-10	19 February 85
11	Ohio	10-0	19 February 85
	Allegheny	0-17	19 February 85
	Ohio	204-10	20 February 85
12	Ohio	17-0	20 February 85
	Allegheny	0-25	22 February 85
	Allegheny	0-17	23 February 85
	Monongahela	0-66	23 February 85
	Allegheny	0-17	24 February 85
	Monongahela	0-53	24 February 85
13	Monongahela	57-66	24 February 85
	Ohio	126-22	28 February 85
	Monongahela	0-13	28 February 85
	Allegheny	0-69	28 February 85
14	Ohio	128-24	1 March 85
	Monongahela	0-12	1 March 85
	Allegheny	0-65	1 March 85
	Ohio	127-79	2 March 85
15	Ohio	64-22	2 March 85
	Monongahela	0-12	2 March 85
	Allegheny	0-64	2 March 85
	Ohio	127-38	3 March 85
16	Ohio	38-22	3 March 85
	Allegheny	0-64	3 March 85
	Monongahela	0-12	3 March 85
	Ohio	127- 26	6 March 85
17	Ohio	26-0	6 March 85
	Monongahela	0-12	6 March 85
	Allegheny	0-64	6 March 85
	Ohio	127-22	7 March 85
	Monongahela	0-12	7 March 85
18	Allegheny	0-65	7 March 85
	Ohio	128-22	9 March 85
	Monongahela	0-12	9 March 85
	Allegheny	0-55	10 March 85

ADDENDUM: SUMMARY OF ICE CONDITIONS, 1984-85 (Full data in Appendix A)

The table below has been added to the atlas because it provides a greatly simplified summary of ice conditions during the 1984-85 winter as observed on the video tapes. Thus the reader can more conveniently study this table than study all the tables in Appendix A.

The accompanying graphs provide data on regional air temperature and river discharge. The reader can use these graphs to determine temperature and discharge conditions prior to and after an aerial video ice observation, during the time when ice was not apparent, and during the time when video tapes were not taken.

The tabular and graphical data which follow may be useful in understanding the distribution of ice as observed, and in estimating ice characteristics during the times when the rivers were not documented on the video tapes.

	Total ice (all ice types)		Predominant ice type			
	Date	Total ice area ($\times 10^6$) (m ²)	Percent* of river	Name	Total ice area ($\times 10^6$) (m ²)	Percent* of river
Allegheny River (3.27×10^6 m ²)						
First ice observed	23 Jan 85 [†]	3.09	95	Fragmented ice cover	2.42	74
Maximum ice extent observed	23 Jan 85 [†]	3.09	95	Fragmented ice cover	2.42	74
Last ice observed	24 Feb 85	0.03	1	Ice floes or frazil slush and pans	0.03	1
Monongahela River (24.30×10^6 m ²)						
First ice observed	28 Jan 85 [†]	12.24	50	Solid ice cover	5.28	22
Maximum ice extent observed	4 Feb 85	15.19	63	Fragmented ice cover with open-water areas	7.16	30
Last ice observed	24 Feb 85	0.02	0	Ice floes or frazil slush and pans	0.02	0
Ohio River Above Hannibal Dam (77.01×10^6 m ²)						
First ice observed	30 Jan 85 [†]	25.99	34	Fragmented ice cover with open-water areas	13.16	17
Maximum ice extent observed	30 Jan 85 [†]	25.99	34	Fragmented ice cover with open-water areas	13.16	17
Last ice observed	20 Feb 85	0.24	0	Ice floes or frazil slush and pans	0.21	0
Ohio River Below Hannibal Dam (208.02×10^6 m ²)						
First ice observed	8 Feb 85 [†]	2.35	1	Fragmented ice cover with open-water areas	1.08	1
Maximum ice extent observed	16 Feb 85	2.83	1	Fragmented ice cover with open-water areas	2.35	1
Last ice observed	20 Feb 85**	0.03	0	Solid ice cover	0.03	0

* Rounded to nearest percent.

† First date of video coverage.

** Last date of video coverage.

